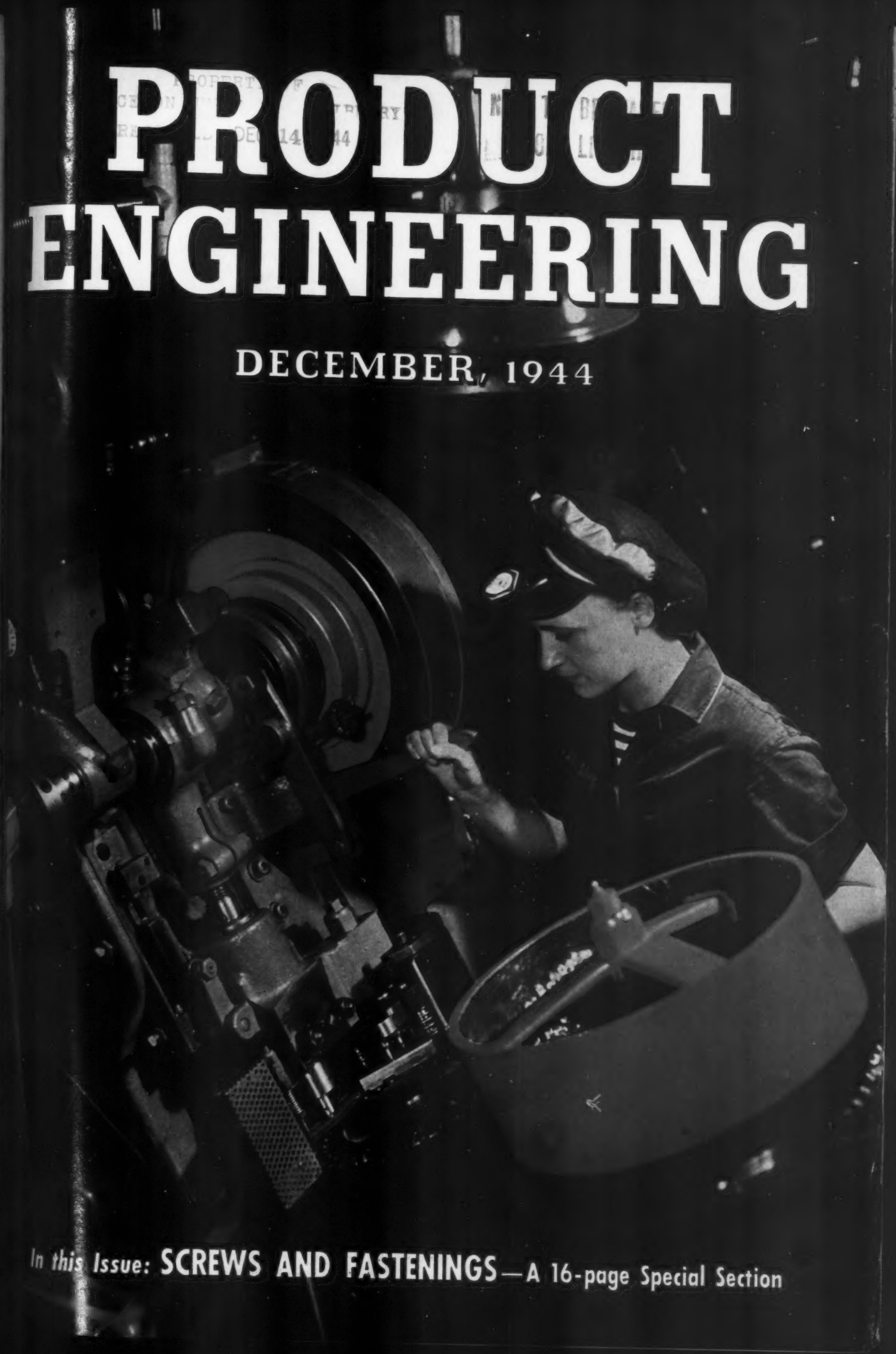
PRODUCT ENGINEERING

DECEMBER, 1944



In this Issue: SCREWS AND FASTENINGS—A 16-page Special Section

They wanted
TOY-SIZE fastenings
able to withstand

¾" long, .037" dia.
140 threads to inch.

"BIG-GUN CONCUSSION

. . . and for these threaded "pin size" parts they chose a strong, corrosion-resistant INCO Nickel Alloy

The enemy isn't the only one to feel the shattering shock of a naval broadside. When the big guns thunder, everything aboard ship takes a beating.

Yet delicate vital instruments must function without a hitch. Every part . . . even the tiniest . . . must be able to withstand the tremendous concussion.

One such part in an essential instrument, is a fastening the size of a common pin . . . approximately ¾" long, .037" in diameter with 140 threads to the inch.

The metal chosen for this fastening needs:

corrosion-resistance, a necessity for sea-going equipment.
strength and toughness, to hold up under shock.
machinability, to permit speedy, economical machine production.

All of these requirements add up to "R" Monel . . . the corrosion-resistant alloy for parts where extra machinability is important.

* * *

This use of "R" Monel is cited as an example of how INCO Nickel Alloys . . . such as "R" and "KR" Monel . . . often do the trick where a *unique combination* of properties is required.

If you have a problem involving metals . . . for equipment now in production, or planned for post-war . . . consult INCO Technical service. Write:

THE INTERNATIONAL NICKEL COMPANY, INC., 67 Wall Street, New York 5, N. Y.

Official U. S. Navy Photograph

140 THREADS TO THE INCH, *shown in this enlarged photograph, demonstrate the remarkable machinability of strong, corrosion-resistant "R" Monel. ("KR" Monel is suggested for applications where extra hardness is required.) The fastenings are machined from .037" diameter cold-drawn "R" Monel.*

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MONEL • "K" MONEL • "S" MONEL • "R" MONEL • "KR" MONEL • INCONEL • "Z" NICKEL • NICKEL
Sheet . . . Strip . . . Rod . . . Tubing . . . Wire . . . Castings

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IN THIS ISSUE—

Cover Picture—Lock nuts with fiber locking collars are assembled automatically on this machine by Elastic Stop Nut Corporation of America. The orange and green colors used on the machine elements are those recommended in the du Pont "Safety Color Code for Industry."

Special Section: Screws and Fastenings

In designing war equipment many tough problems related to the fastening of component parts have arisen. Some of

them have been overcome by developing special fastening devices. Others have been solved by modifying standard screws and bolts. Numerous prewar fasteners developed for specific applications have been found helpful in other uses never previously considered. The special section in this issue, starting on page 825, reviews and summarizes various types of screws, nuts and locking devices and the standards pertaining to them. The patented-types of fasteners and fastening devices are also covered.

Field Research

Searching out customer reactions to regular products and proposed new products is a significant part of field research programs. James O. Peck, president of the field research company which bears his name, presents some pertinent observations on the subject of field research in his article beginning on page 793. He cites some concrete facts to bear out the importance of companies engaging in field research surveys before launching product development projects.

Cleaning Magnesium Surfaces

Increased availability of magnesium and magnesium alloys has spurred interest in the best procedures for its use in fabricating parts. Since magnesium, like aluminum, requires surface preparation before spot welding, Boeing Aircraft Company set about to determine the most satisfactory cleaning method. An article on page 811 reports on the study and its findings.

Production Considerations

Functional efficiency, which is the first objective of engineering design, must be supplemented by considerations of economy of production and limitations of fabricating equipment. Redesign often results in easier and more economical production without sacrificing functional efficiency. In an article starting on page 813, A. H. Petersen, production design manager, Lockheed Aircraft Company, outlines basic factors influencing design for production and gives a number of examples of economical fabrication. The Reference Book Sheets on pages 856, 857 and 858 present standards for cylindrical fits and tolerances, and for pin and bolt holes. These standards are recommended because of the appreciable savings they effect in production costs.

Surface Roughness Finish

James A. Broadston, Armament Engineer, North American Aviation, Inc., presents in this number the fourth and concluding article in a detailed presentation of reasons why specific steps should be taken in standardizing surface roughness finish values. In his article beginning on page 806, Mr. Broadston describes taper-sectioning technique for establishing defined standards and methods of determining RMS microinch values from Brush Analyser tapes. In his conclusions, Mr. Broadston points the way to international consciousness of the advantages and savings to be derived from an adequate program of surface quality control.

Hydraulic Circuits

Application of hydraulic operation to machines and processes has reached a degree of complication almost comparable to electric circuits, with which hydraulic systems are often combined when designing for automatic sequencing of mechanical operation. The hydraulic circuits illustrated on pages 818 and 819 are a continuation of those in November PRODUCT ENGINEERING, and together with them indicate the variety of combinations of equipment and the possibilities of using hydraulic operation when several operations must be timed accurately with respect to each other.

Electrical Aircraft Equipment Developments

Electrical and mechanical engineers have created seeming miracles of design in answer to the many new problems with which the aircraft industry has confronted them. Lt. Col. T. B. Holliday, engineering division, equipment laboratory, Wright Field, see page 841, reviews the progress made in the design of electrical aircraft equipment over the last 20 years and cites opportunities for further improvement and advances in airborne engine generator units, ground power units, batteries and control accessories.

Chemical Properties of Plastics

One of the most important characteristics of any plastic material is its ability or inability to enter into a chemical reaction. Resistance of the material to chemical action is, therefore, known as chemical resistance. See page 845 for a thorough discussion of this property of plastics, with data indicating the ability of various specific materials to resist chemical attack. This is the fifth in a series of articles covering the design of plastic parts.

Annual Index

The 1944 annual index, Volume XV, of PRODUCT ENGINEERING is included in this issue. The index divisions are: Alphabetical by titles; classified by subjects; authors' index.

WHAT'S COMING—

Advantageous Engineering Teamwork

Out of the pall of global war shines the superb teamwork between American and British engineers in matching and overcoming the scientific developments and engineering ingenuity of enemy nations. G. Geoffrey Smith, M.B.E., representing the British Supply Council for the interchange of technical information, will present his views on this teamwork in a forthcoming article. He expresses the hope that engineering teamwork between the two nations continue undisturbed in the peacetime years ahead. Mr. Smith will review the engineering concepts impressed upon English and American engineering students, and point to some of the outstanding achievements recorded by British engineers in meeting the demands of modern war.

Hydraulic Systems

In adapting automatic hydraulic controls to machinery, engineers must consider the advantages and limitations of various types of pumps, packings, valves, cylinders, and motors in addition to applying the fundamentals of hydraulics to the design of complete systems. In February 1944 PRODUCT ENGINEERING published a 16-page report on hydraulics. As a follow-up to this insert, a series of analytical articles on hydraulic components and circuit design will be presented. The series, prepared by Howard Field, consultant, will begin with a complete discussion of pumps.

New Service for Readers

Beginning with the January number and continuing monthly thereafter, abstracts of technical papers of significance to design engineers will be presented. Highlights of the papers will be reviewed with a listing of sources for further details.

PRODUCT ENGINEERING

DECEMBER, 1944

Field Research Studies Essential to Product Development

JAMES O. PECK
Industrial Field Research Consultant

Knowledge of the customers' desires makes the problem of product design less abstract. Such studies go hand-in-hand with technical analyses for meeting commercial requirements in product development. Typical examples of contributions made by field research to the salability of products are presented.

EXCEPT for the unusual designs which are of an exceptionally advanced nature, the engineer finds little difficulty in the solution of the technical problems involved. From the ever growing fund of technical data and the established mathematical relations between load stress and deflection, the properly qualified design engineer is usually able to arrive at a close approximation of the correct answer. At least his calculations are so nearly correct that he is able to build a working model. This test reveals the deficiencies of the machine and the points where improvements should be made. Admittedly, this is not a simple procedure, but on the other hand, complex though it be, it is entirely within the power of the engineer to finally achieve the proper results. The fundamental reason for this is that the engineer knows by his analysis of the problem the technical requirements that must be met.

Unfortunately, the service requirements and customer requirements relative to a product do not lend themselves to a mathematical technical analysis. In attacking this phase of the product design problem, the engineer is faced with the fact that there are no mathematical relationships or scientific rules by which he can predetermine customer likes and dislikes, service conditions that will be encountered in the field, special features of the product that will have sales appeal, unique characteristics that will intrigue the prospect and operating features that will be reflected in operating economies. No amount of office study can possibly reveal the desired information primarily because there can be no solution to a problem until the problem has been discovered.

The significance of the value for a close first-hand study of customer needs and desires was strongly demonstrated in the remarkable success in the development of an improved loom for weaving cotton cloth. For many decades, the manufacturers of such machines had designed model after model with no notable improvements in successive models, at least from the textile manufacturers point of view. It was about 1930 when the executives of one of the leading manufacturers of cotton looms engaged the services of a trained engineer to develop the design of a new loom that would possess striking sales values. They naturally expected this man to plunge immediately into the engineering department and start the slide rules slipping and the bow pens drawing lines. They were wrong. The new executive engineer proposed an entirely different line of attack and followed it. He hired groups of young engineers, recent college graduates, to go into the plants of the customers and make detailed records of the performance of the looms. Using stop watches, these men recorded the running time and the down time of the machines. Every time the automatic mechanisms stopped the machine because a thread broke, the fact was recorded and also the reason for the breakage of the thread. Minute by minute production records were kept. Detailed records were also made of the repairs required in the customers' shops and how long it took to make the repairs. Thus, a vast fund of information was gathered.

The information obtained from the study of the performance of the looms in the customers plants was then tabulated and analyzed. Thus, were established the problems that the customer encountered in the operation of the machines. This field research revealed wherein significant improvements could be made in the design of the looms. Such improvements not only referred to operating characteristics, but also simplicity of maintenance and economy of repair. The study indicated where the design could be improved by the use of more expensive ball bearings in place of sleeve bearings, welded construction in place of cast construction, metal springs in place of resilient hickory, machined surfaces in place of cast surfaces, lightweight stampings in place of castings, and many other features.

With all the various phases of the design problem correctly established, it

was a relatively clear-cut job for the engineering department to create the kind of design to meet the established requirements. In this particular case, one of the amazing results was that the improved model not only possessed about thirty percent greater production capacity, but was far superior in operating characteristics and maintenance and also cost less to manufacture. This is perhaps the most striking example of the power of field research to establish the engineering requirements for an improved design.

The irony is that most companies will wisely spend huge sums in making comparative studies of their own products and those of their competitors in order to measure the relative qualities and thereby build data for competitive arguments in favor of their own products. Insofar as it goes, this is good business, but it should be emphasized that in such a procedure the criterion for excellence becomes the qualities of the competitor's product and not the degree to which the product meets customer needs and desires. Such a business philosophy fails to recognize the fact that it is the customer who is the final score keeper on all their efforts and that the score will be high only in proportion to the degree to which the manufacturer understands the customer's needs. The fact that the customer himself does not understand his needs is no excuse. It is not until these needs have been clearly established that the product design problem becomes other than abstract. It then is no longer a matter of debatable opinions of various individuals within the company.

When field reports are made by qualified investigators and they clearly indicate changed conditions in the use of a product, there is little disposition to defend "The good old ways." This is in strong contrast with the attitudes when salesmen report changed conditions. The salesman's explanation for the loss of an order is too often looked upon as an alibi rather than something they should investigate further. Nor is it logical that the policy of a company should demand that kind of sales leadership. Rather, the company should always be leading the salesmen in uncovering changes or threats of changes in the customers' acceptability of the product. In ironing out this problem, field research can help immeasurably.

It seems ironical, but it is true, that the older the product or industry, the more likely it is for the company to fail in sizing up the product features and improvements that would have direct sales values. Too often the old products are taken for granted by the manufacturer and he fails to realize how much both the company and its customers could benefit by a thorough field study of the customers' needs.

Many years ago the conventional spring lock washers of that day were looked upon as a product that would not lend itself to worthwhile improvement. The prevailing opinion was that the product was so simple that nothing could be done to give it increased sales value. One of the companies in this field, however, introduced a careful detailed study of not only the uses of such lock washers but also the problems encountered by their customers in using these lock washers.

The common experience of users of lock washers in that day was to have the washers tangle and nest in their boxes. This required the shop man using the washers to first spend a great deal of time unraveling the linked mess of washers. Obviously if the washer were redesigned so that it could not link with other washers there would be no need for this lost time in the shop. So the old lock washer manufacturer redesigned his lock washer so that it would not nest. He also studied the best applications for such lock washers. With his sales arguments built up on the basis of the facts that were uncovered in his field study he was able to achieve a strong place in the market. It is ironical that this manufacturer would not undertake the field research until his dwindling market compelled him to do something. If he had had a modest and continuous field research program having as its objective a sincere desire to help his customers, he would have avoided the big headache that he ran into when he was forced to do something.

Perhaps the most significant and important thing about field research is that it replaces opinions with facts. Frequently opinions are so strongly anchored in the mind of the manufacturer that he consideres them as facts and draws his conclusions accordingly. The harm in this is that he often fails to develop ideas that opinion dictates to be wrong and thereby he commits serious errors of omission. Recently a manufacturer said that he wanted to find new markets for a wartime product. He explained that the product was precision-built and therefore high-priced. Because of this, he asserted, it would be no use to investigate the possible market of this product among such mass production, price-conscious buyers as the automobile manufacturers. This opinion which the manufacturer looked upon as fact, seemed to him to preclude the possibility of the highly desirable automotive market.

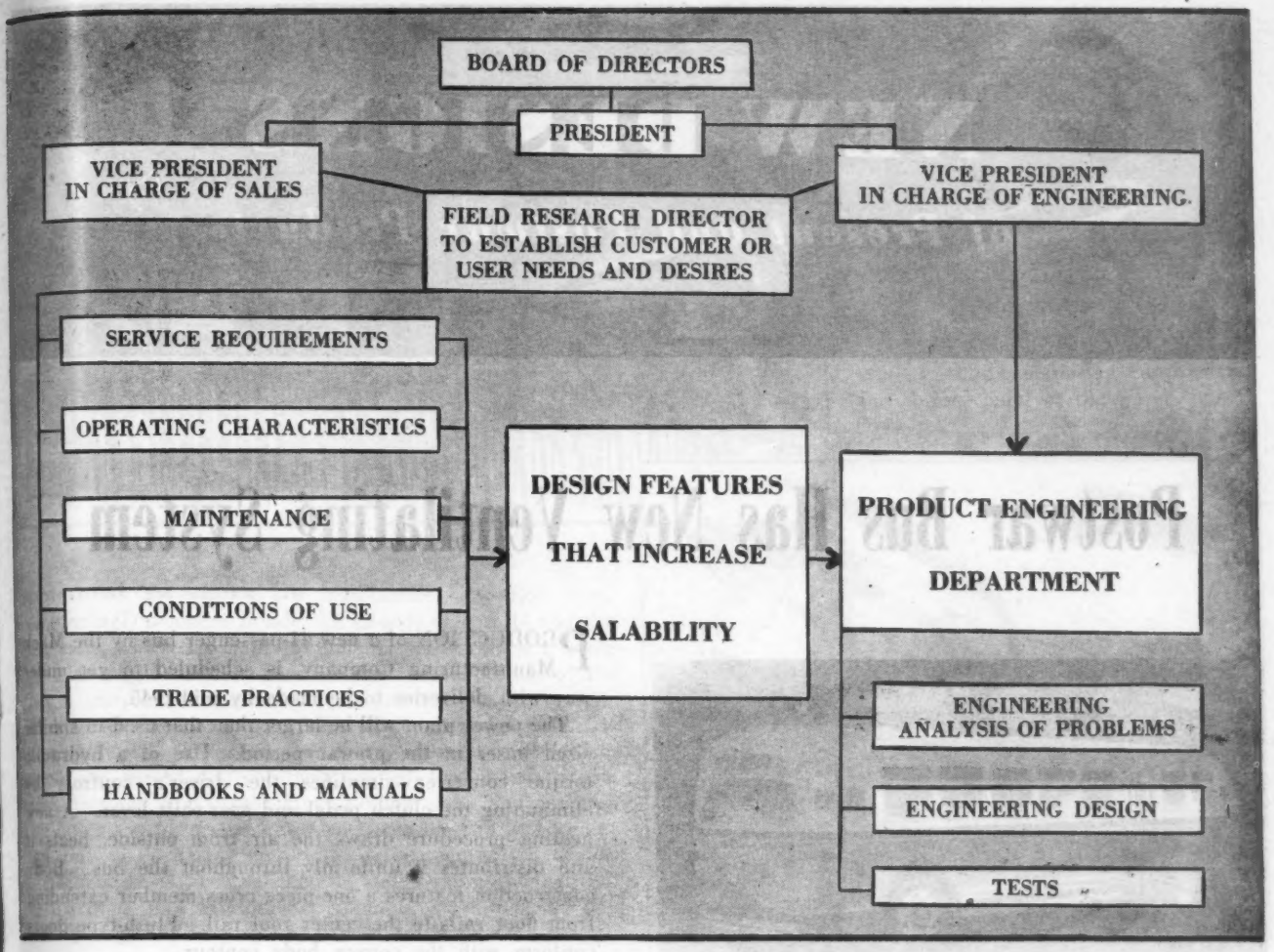
Despite the manufacturer's warning and insistence that his product had no market in the automotive industry, a field research representative stopped in to see the design engineers of one of the low-priced car manufacturers. He showed them the device and they were immediately much interested, in spite of the obvious high price of the precision-built part. A number of significant facts caused these engineers to give the product serious consideration. In the first place, because this device served the same function as an assembly of gadgets then in use, it would save a great deal of money through the elimination of the cost of assembling the numerous low-priced components they were then using, and money would therby be saved in the assembly line. Secondly, the design engineers believed that this high-priced precision unit would perform better and reduce maintenance costs. Thus the product which, as dictated by opinion, was too high-priced for the automotive industry was found to be peculiarly suitable, economically and functionally, for use in that field.

Many manufacturers are now forced to seek new markets or to break into other markets with new products after the war, especially among capital goods manufacturers. It seems that everybody is going to make electrical appliances or prefabricated houses after the war. For instance, machinery manufacturers have been spending a great deal in the consideration of new products.

In many instances it has been shown by field research that many users of various types of machinery are bitterly disappointed with the quality of machinery they can buy. Many such companies maintain design departments and machine shops to redesign and rebuild the equipment they purchase. One naturally wonders why the machinery suppliers don't build better machines to begin with. This they can do, but only if they are thoroughly informed on their customers' problems in the use of the machine and the objectives that must be attained in their design.

Field research has shown machinery builders that there is plenty of opportunity for them in their present markets. Those are the markets in which these manufacturers can put to best use their fund of past experiences. Many such manufacturers have already seen the light and are now engaged in refining for the postwar period their old line of products on the basis of field studies of their customers' needs.

Not only does field research help immeasurably in indicating the directions for product improvement but it has helped substantially in avoiding costly mistakes. For example, one large company that rates high in advertising circles prided itself for its skill and thoroughness in turning out instruction



This chart indicates how field research ties in with company organization for product development. After field research has completed its survey of practical requirements which suggest design features, the information goes to the product engineers for technical development. Such procedure aids in eliminating one-sided debates on the part of various department executives within the company.

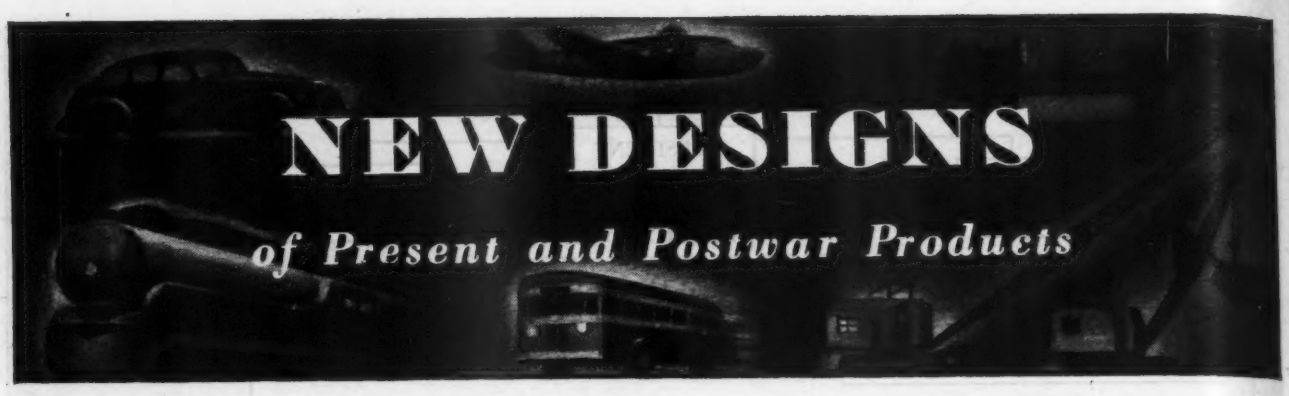
books, data sheets and the like for the use of their customers in the operation of the machines they sold them. However, an investigation by field men revealed that this literature has been cited by the manufacturers as an example of the kind of instruction books that they don't want. The booklets are over the heads of the machine operators and thereby leave all the burden of instruction in the hands of the customers. The books would have been more effective and useful if they had been based on data uncovered by field research.

The facts and conditions to be met by the design of a product as set forth by the customer can be established by field research. All of the debaters in the company meetings, could read the reports of field research and thereby begin their debate from a common premise. Such a condition will surely seem like the millennium to the hundreds of administrative executives, design engineers, sales engineers, advertising engineers, production men and others in responsible positions who yearn for the day when "The other fellow" will get reasonable and appreciate their particular viewpoint. Such a condition can only be achieved when every individual in the group has a clear picture of the customers' viewpoints. Then will it be possible for the respective skills of the various executives to be coordinated into logical action and decision.

It is not contended that field research must be contracted on a grandiose scale. To the contrary, it should be started on a modest scale and its values should be tested and proved in one spot at a time. Each of the findings must be fitted into the company's operating procedure, and necessary modifications should be made to coodinate properly the efforts based on new findings.

It is not implied that field research results in immediate perfection through violent changes. To the contrary, it is nothing more than a sound method of working to improve percentages. Many business men have had an unhappy experience with field research because they were given too big a dose at one time instead of being given small doses at a time. If the field research is undertaken as a huge organized effort, it is likely to wind up as a complicated statistical study that no one knows what to do with because the reasons for the figures are missing. Figures in themselves are misleading. It is only the reasons behind them that give them clarity and significance.

Especially at a time like the present when so many companies are faced with the problem of extending the markets of their old line of products or contemplating new fields into which to venture it is highly important that their actions and decisions shall be based on facts rather than fancies. The sales value and market possibilities of every product are determined solely by the usefulness and appeal of the product. The determination of these two factors can be obtained only by a study of the customers' needs and desires, and he is the final scorekeeper on the success or failure of the product as a commercially salable article.



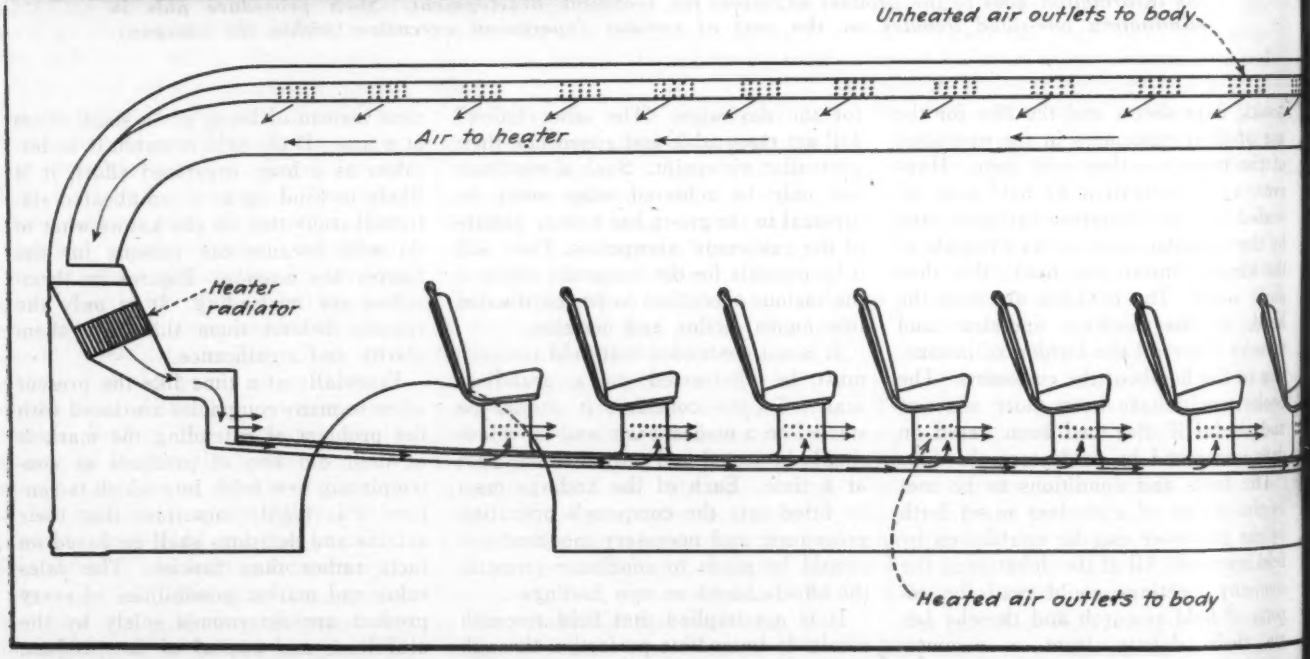
NEW DESIGNS

of Present and Postwar Products

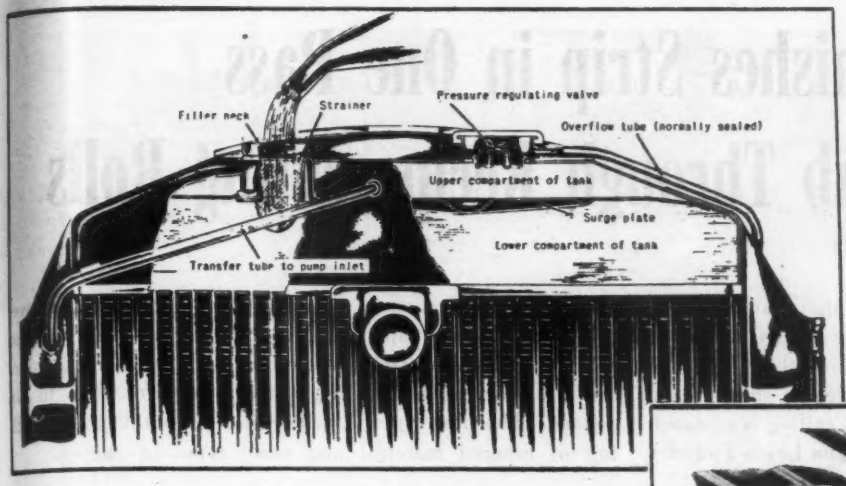
Postwar Bus Has New Ventilating System

PRODUCTION of a new 41-passenger bus by the Mack Manufacturing Company, is scheduled to get under way with deliveries to be made by mid-1945.

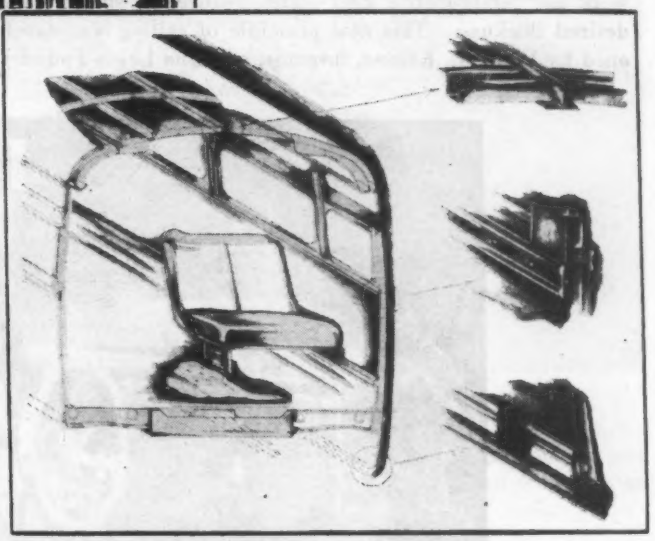
The power plant will be larger than that used in similar sized buses in the prewar period. Use of a hydraulic torque converter simplifies the driver's controls by eliminating the clutch pedal and gear-shift lever. A new heating procedure draws the air from outside, heats it and distributes it uniformly throughout the bus. Body construction features a one-piece cross member extending from floor rails to the center roof rail. Flush-type doors conform with the convex body contour.



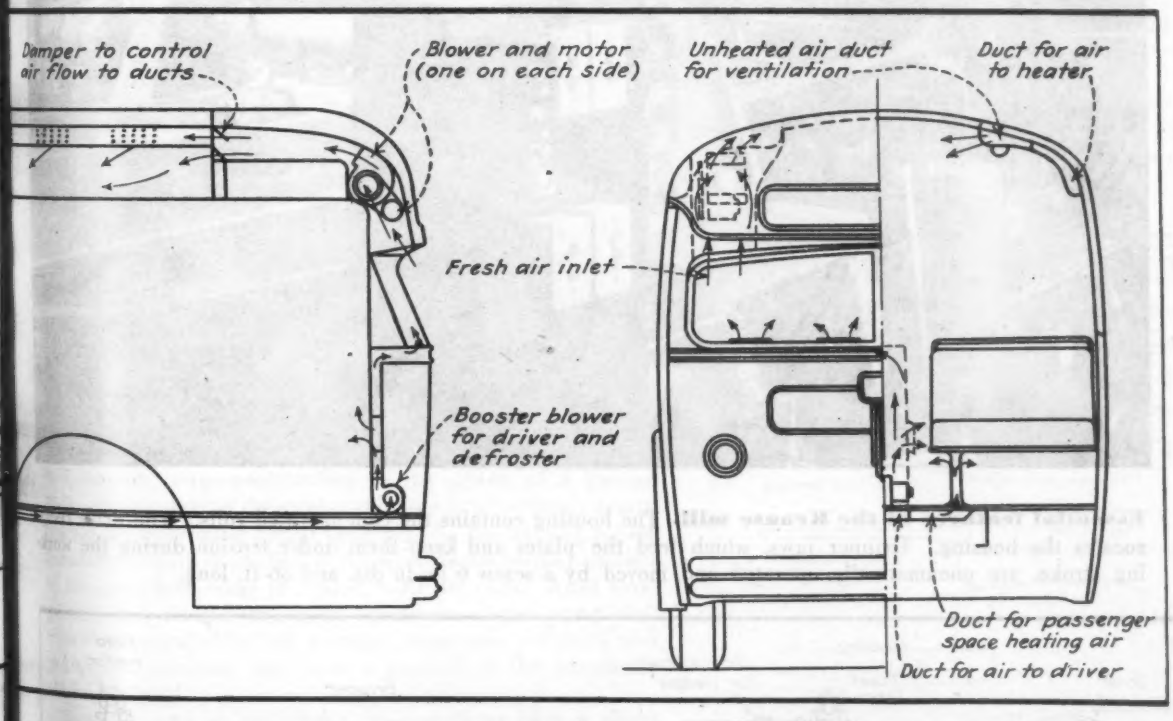
Heating and ventilating system, of the power-driven type, has sufficient capacity to effect a complete change of air every minute. Two squirrel-cage blowers draw fresh air into the body either through a water-repelling roof opening, 30 in. from the front of the bus, or at the windshield cowl. Air then flows through four ducts built into the two sides of the ceiling. The two inner ducts serve openings by which fresh air is introduced directly; the two outer ducts lead to the rear where they connect with the central heater, a small radiator installed



Design of the radiator tank conserves coolant. The tank consists of two compartments separated by a horizontal surge-plate, a deep filler neck and a pressure cap. The pressure cap is permanently installed and serves to trap air in the upper compartment above the filler neck level, and maintains a pressure of 7 lb. above atmospheric pressure in the coolant system thus increasing appreciably the boiling point of the water.



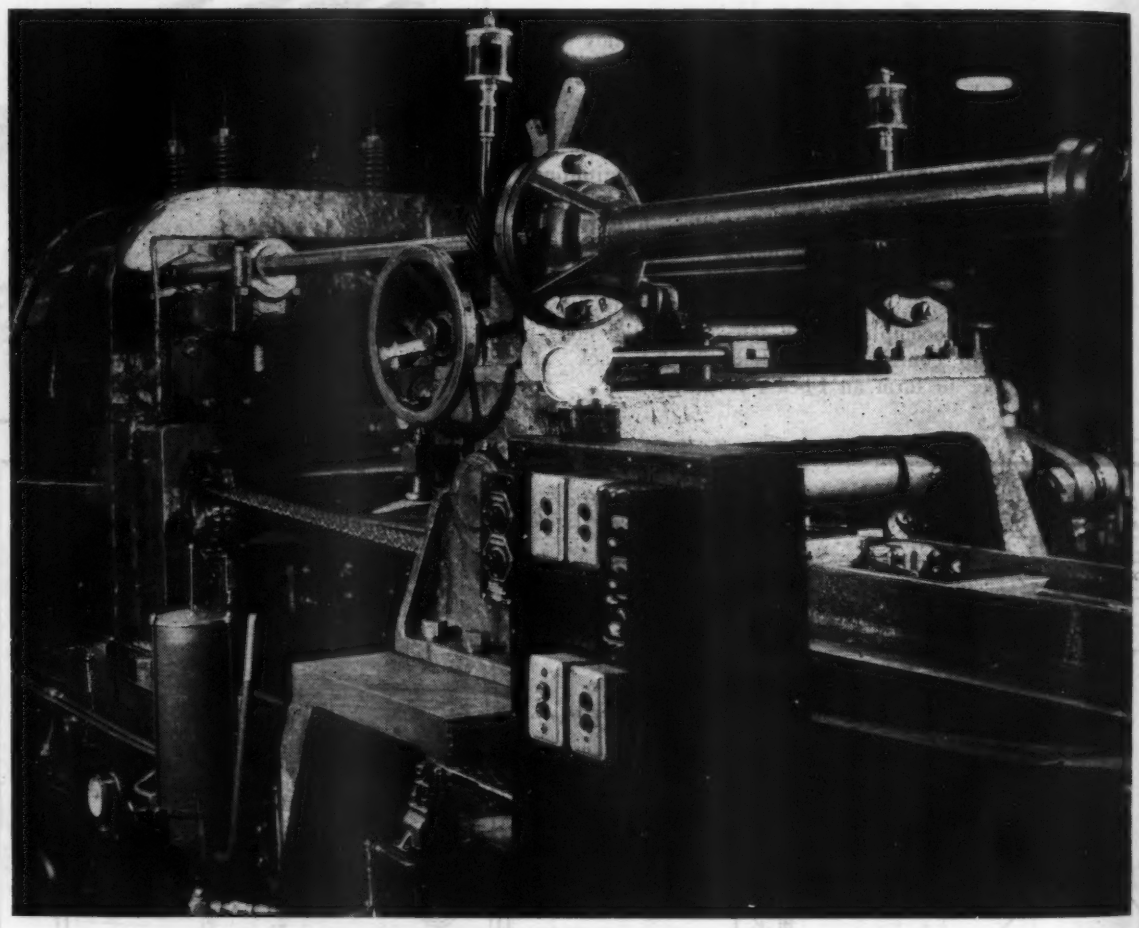
Structural members are high-tensile, low-alloy steel. Longitudinal members inlude the chassis side rails and the floor rails, which are both continuous. Side rails are made up of an angle reinforcement at the curved bottom of the skirt, a seat rail, inside and outside belt rails and eave rails all of which are continuous. The three roof longitudinals are continuous. Transverse members consist of side-bearers which are essentially continuations of the chassis frame cross-members, and combination window posts and carlines. The latter are formed in one piece from floor rails to center roof rail on each side, and welded together at the center. This junction is accomplished by telescoping the ends of the carlines into continuous channels, back-to-back, and welding together to form an I-beam ridge pole.


Damper to control air flow to ducts
Blower and motor (one on each side)
Unheated air duct for ventilation
Duct for air to heater
Fresh air inlet
Booster blower for driver and defroster
Duct for passenger space heating air
Duct for air to driver

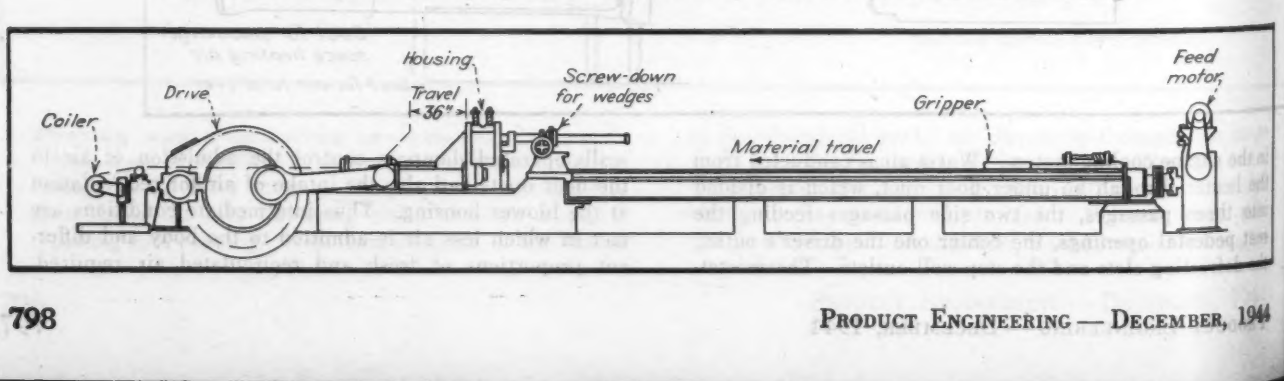
in the engine cooling system. Warm air is conducted from the heater through an under floor duct, which is divided into three passages, the two side passages feeding the seat pedestal openings, the center one the driver's outlet, the defrosting slots and the step-well outlets. Thermostatically-operated dampers control the admission of air to the floor ducts and also the intake of air for recirculation at the blower housing. Thus intermediate conditions are met in which less air is admitted to the body and different proportions of fresh and recirculated air required.

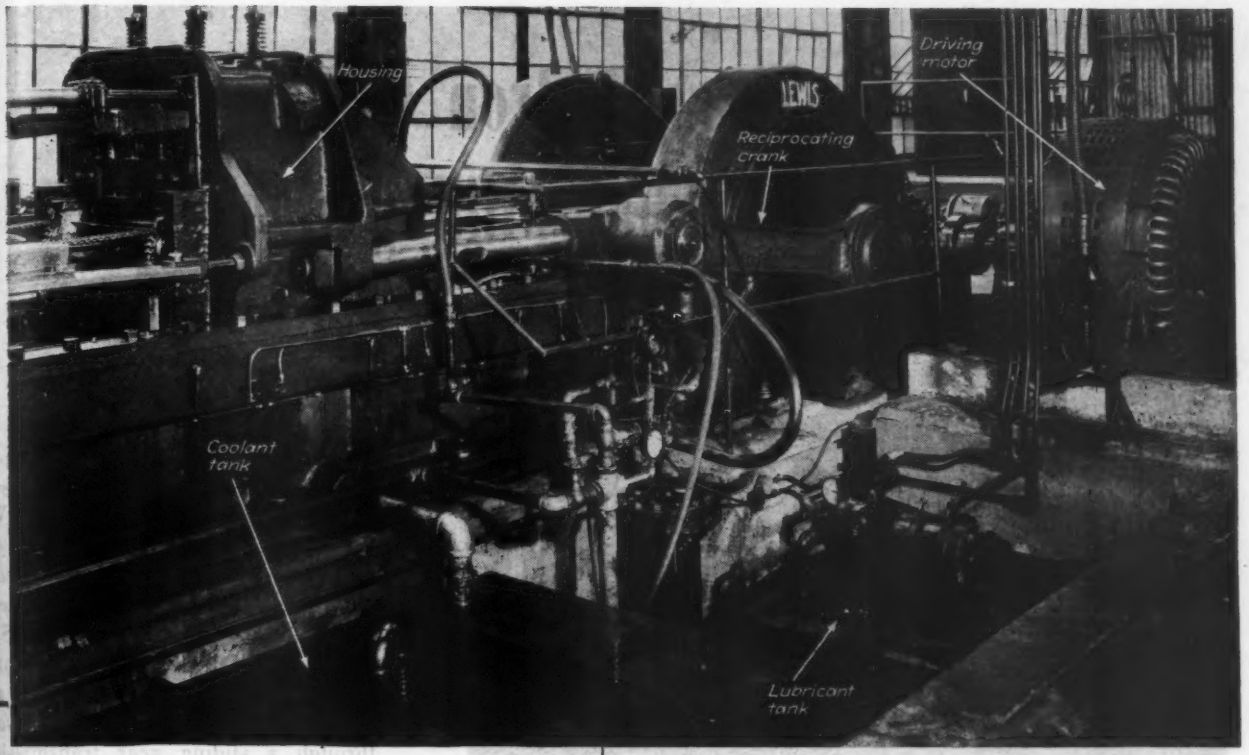
Mill Finishes Strip in One Pass By Feeding Slab Through Reciprocating Rolls

INSTEAD of passing through conventional power driven rolls, material is held stationary in tension by a gripper while floating rolls, moved by frictional contact between the work and reciprocating cam plates, reduce the sheet to the desired thickness. This new principle of rolling was developed by Frank R. Krause, inventor, and The Lewis Foundry and Machine Division of the Blaw-Knox Company at Groveton, Pa. Material up to 28 in. wide can be reduced from ½ in. thickness to 0.030 in. gage in one pass. Such reduction by conventional rolling usually requires four to six passes. The new type of mill is also adaptable to the rolling of tapered material and some types of shapes.

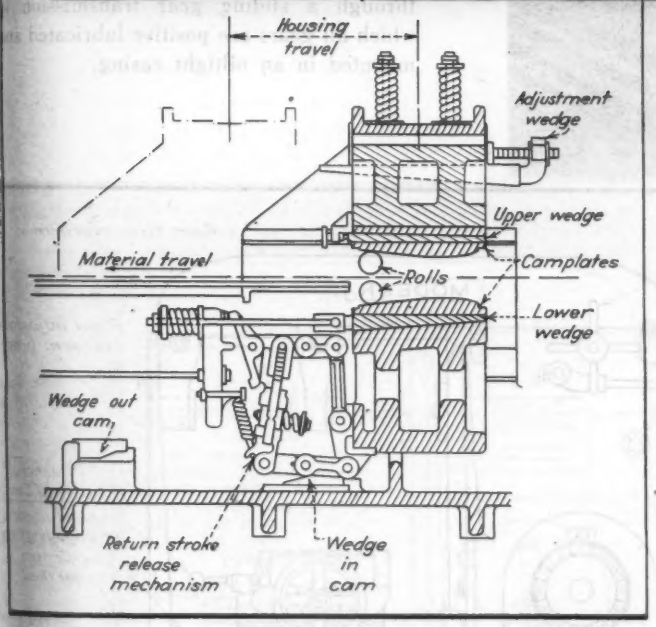


Essential features of the Krause mill. The housing contains the cam-operated rolls. The drive reciprocates the housing. Gripper jaws, which feed the plates and keep them under tension during the working stroke, are pneumatically operated and moved by a screw 6 in. in dia. and 36 ft. long.





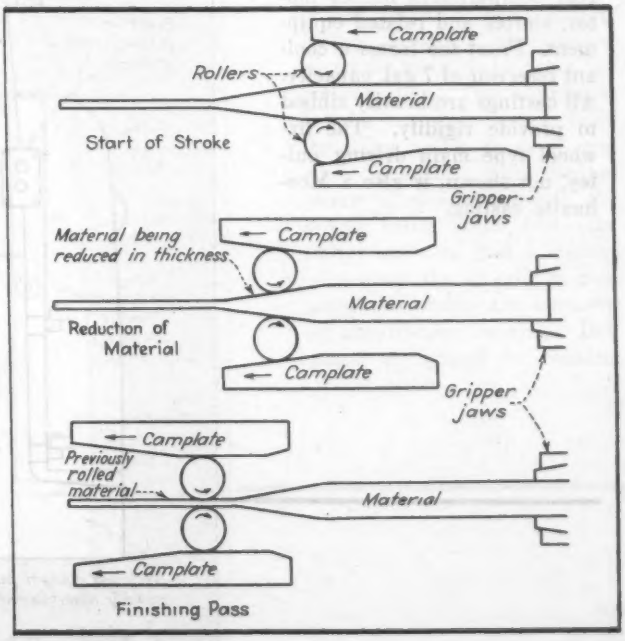
Heavy construction is characteristic of the mill housing and attendant reciprocating parts which weigh ten tons and operate at 62 strokes per min. Coolant is kept in an 800-gal. tank and lubricant in a 400-gal. tank.



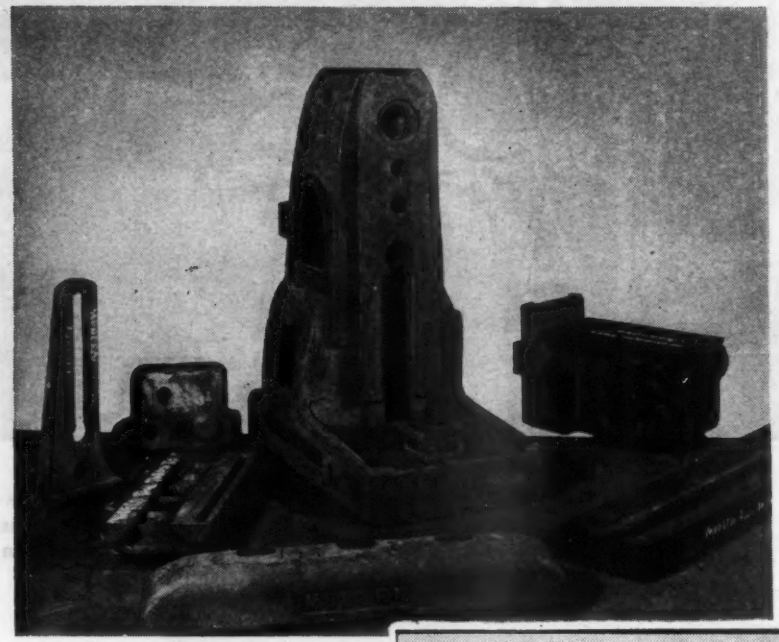
Schematic representation of the action of a Krause Mill. At the start of the stroke, rolls are in a position slightly behind the previously rolled material. As the housing moves forward pressure is applied to the work as the thicker portion of the camplates come in contact with the rolls. After completing the desired reduction, portions of the camplates, which are parallel to the material, pass over the rolls and perform a finishing pass over a portion of the previously rolled material.

Near the end of the stroke the camplates have a slight reverse angle to release the roll pressure. At the end of the stroke, a cam-operated mechanism withdraws a wedge from the lower camplate, thus the lower roll drops sufficiently to allow the rolls to be returned to their original position in preparation for the next working stroke.

The rolls, which are 4 in. in dia. and 28 in. long, are adjusted by a system of wedges located between the plates on the mill housing and the camplates. Two manually operated screw downs move the wedges, setting them to roll the desired gage. The gage can be changed while rolling to produce a single sheet with several thicknesses for jobbing work.

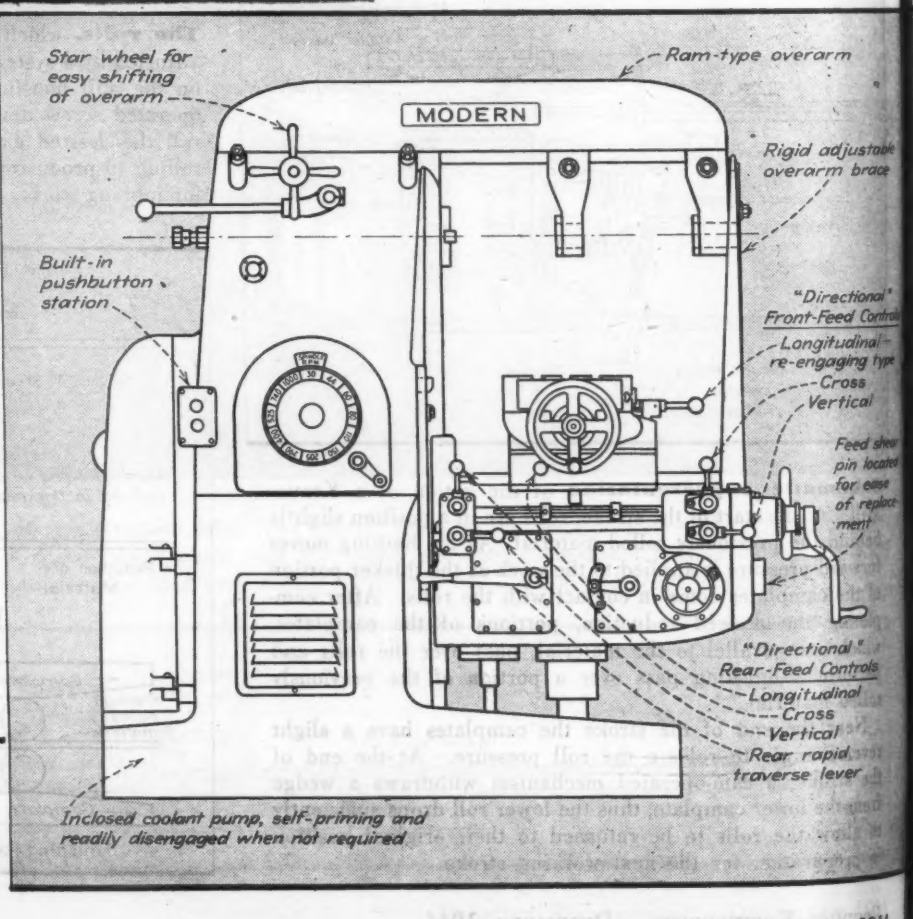


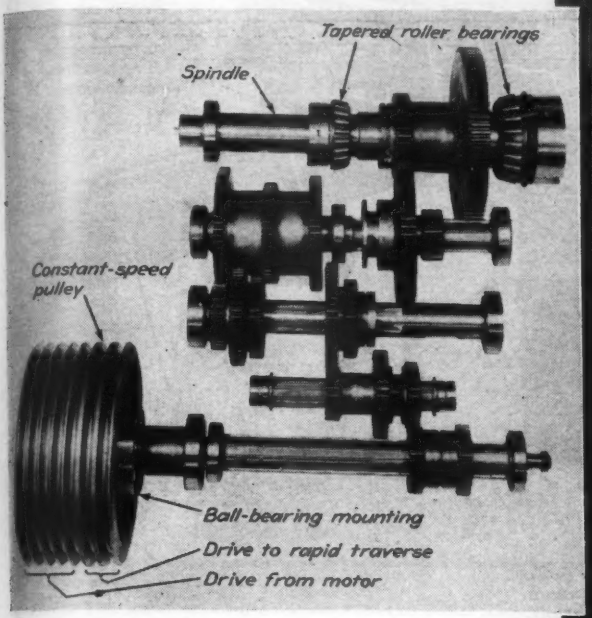
High-Strength Iron Castings In New Canadian Milling Machine

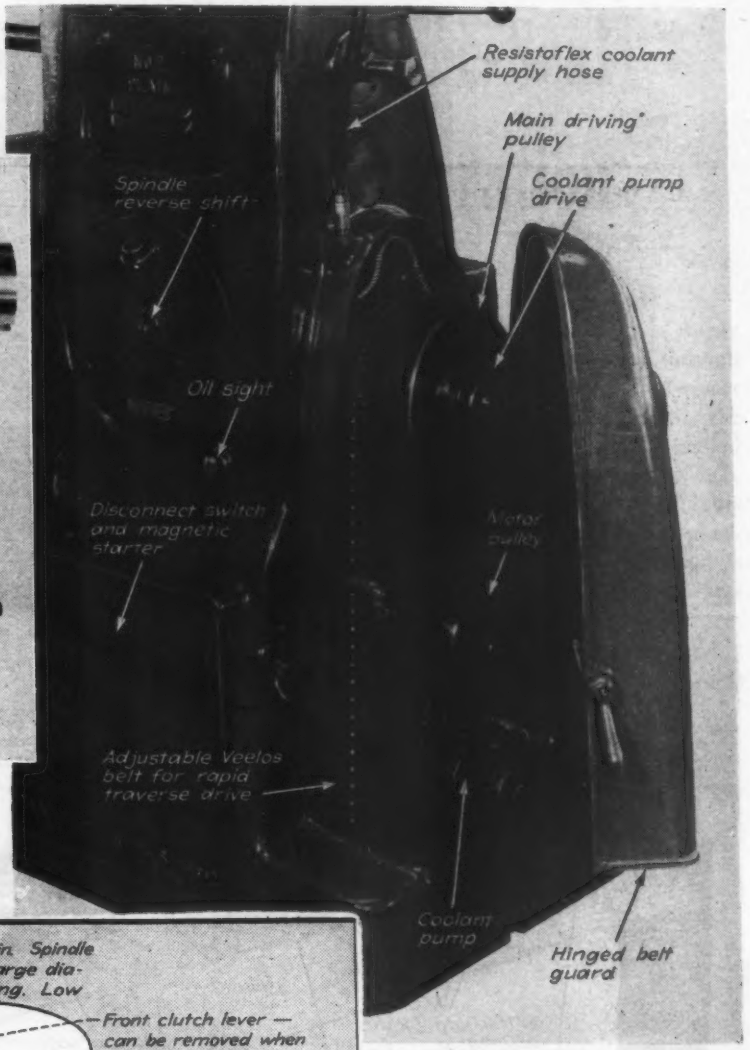


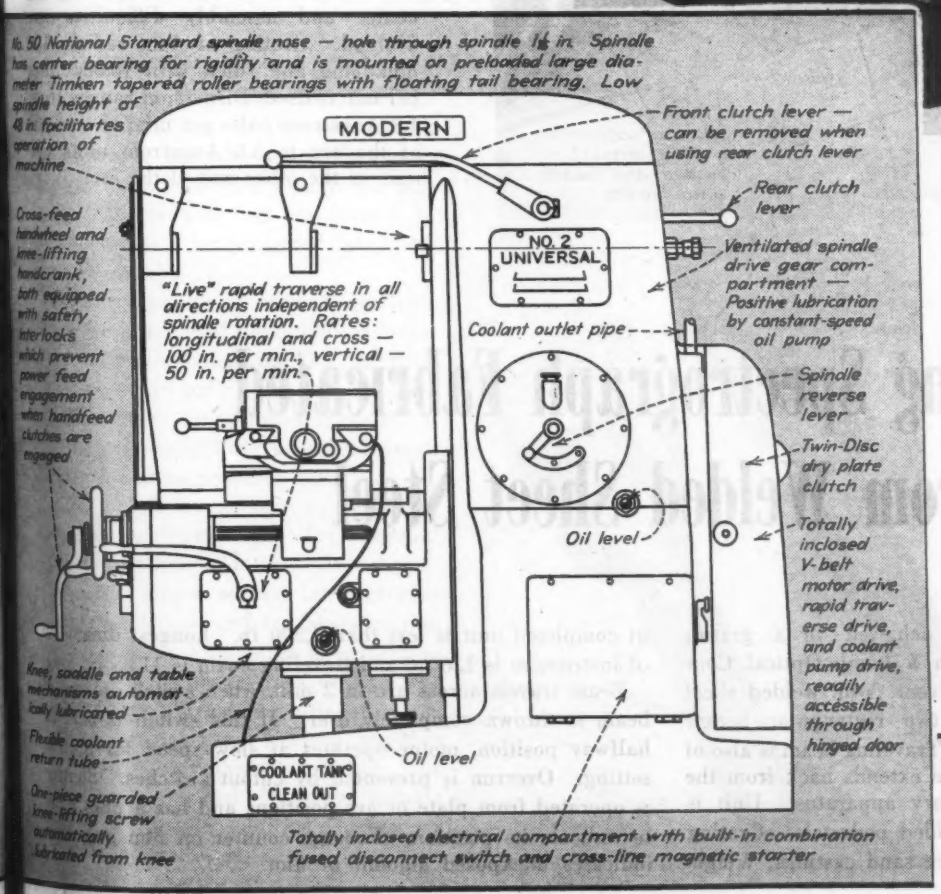
DESIGNED for toolroom and production milling operations, this new machine, built by Modern Tool Works, Toronto, Canada, makes extensive use of high-strength iron castings. Main column, table, compound saddle, knee bracket, and overarm are cast in Meehanite. Spindle is of high-tensile alloy steel mounted in preloaded Timken tapered roller bearings. Twelve spindle speeds are available through a sliding gear transmission in which all gears are positive lubricated and mounted in an oiltight casing.

Rough castings before machining. Main column has three compartments. Upper compartment houses main spindle and gear shafts. Lower rear compartment houses motor, starter and related equipment. Front toe forms a coolant reservoir of 7 gal. capacity. All castings are heavily ribbed to provide rigidity. The flywheel type main driving pulley, not shown, is also a Meehanite casting.

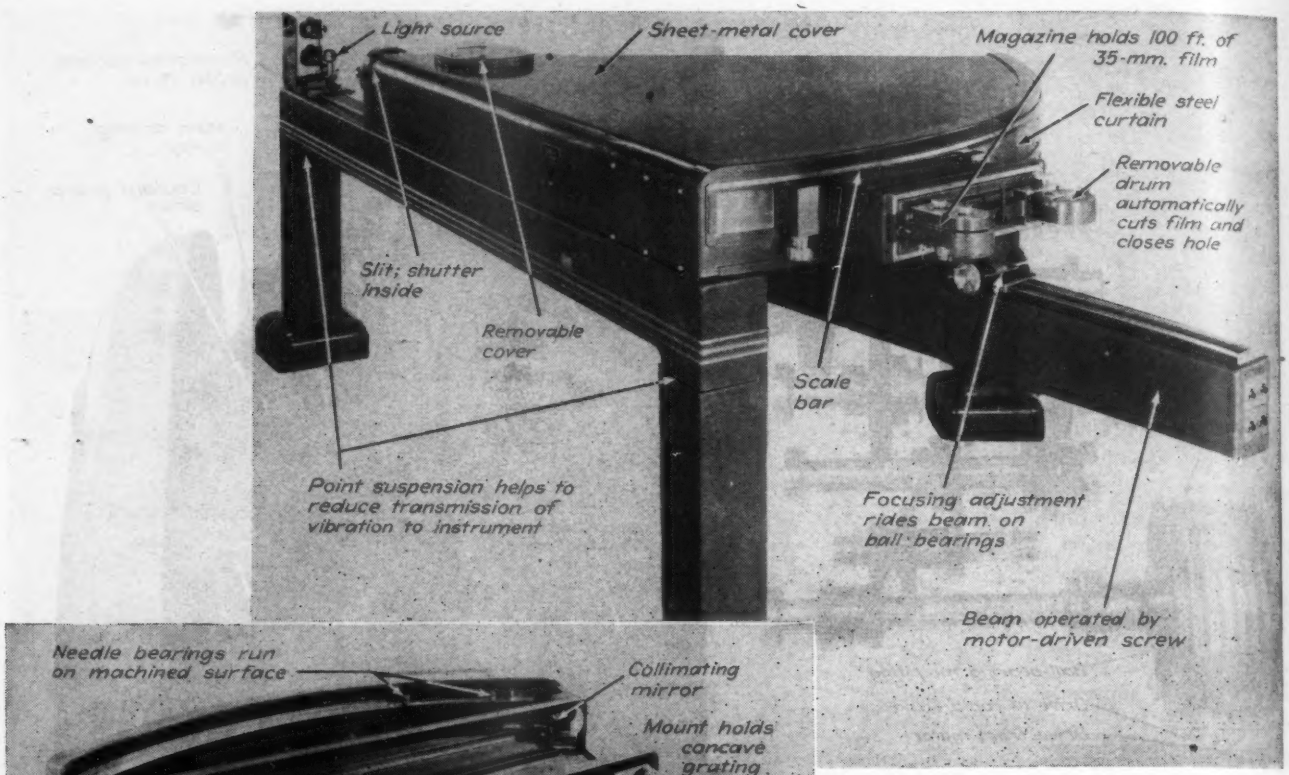


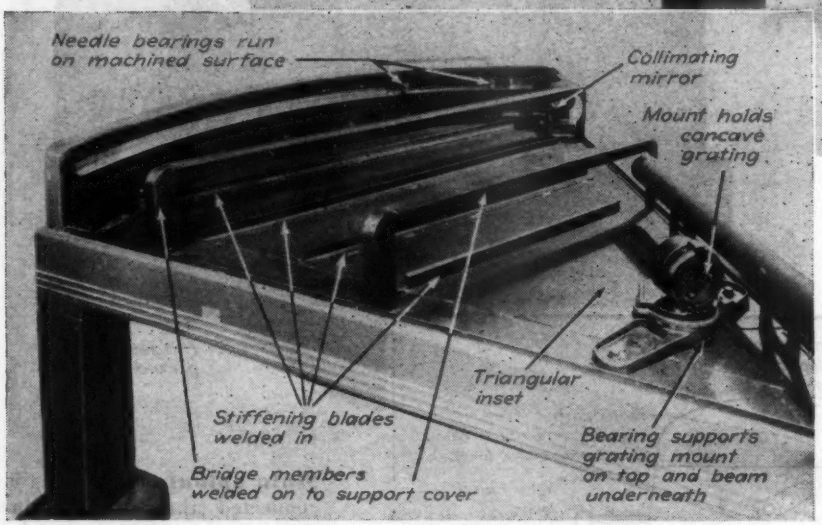





No. 50 National Standard spindle nose — hole through spindle 1¼ in. Spindle has center bearing for rigidity and is mounted on preloaded large diameter Timken tapered roller bearings with floating tail bearing. Low spindle height of 48 in. facilitates operation of machine
MODERN
Front clutch lever — can be removed when using rear clutch lever
Rear clutch lever
NO. 2 UNIVERSAL
Ventilated spindle drive gear compartment — Positive lubrication by constant-speed oil pump
"Live" rapid traverse in all directions independent of spindle rotation. Rates: longitudinal and cross — 100 in. per min., vertical — 50 in. per min.
Coolant outlet pipe
Spindle reverse lever
Twin-Disc dry plate clutch
Oil level
Totally inclosed V-belt motor drive, rapid traverse drive, and coolant pump drive, readily accessible through hinged door
Cross-feed handwheel and knee-lifting handcrank, both equipped with safety interlocks which prevent power feed engagement when handfeed clutches are engaged
Knee, saddle and table mechanisms automatically lubricated
Flexible coolant return tube
One-piece guarded knee-lifting screw automatically lubricated from knee
COOLANT TANK CLEAN OUT
Oil level
Totally inclosed electrical compartment with built-in combination fused disconnect switch and cross-line magnetic starter

Main spindle and gearing is connected through a Twin-Disc clutch and brake to the heavy Meehanite drive pulley. Pulley is driven at constant speed by five V-belts from the motor pulley. Two adjustable V-belts transmit power from the drive pulley to rapid traverse gearing. The coolant pump is also belt-driven, the power being taken from the pulley shaft so that it pumps only when the spindle is running. All shafts are mounted on anti-friction bearings. Belt guard is hinged to column.


Light source
Sheet-metal cover
Magazine holds 100 ft. of 35-mm. film
Flexible steel curtain
Removable drum automatically cuts film and closes hole
Slit; shutter inside
Removable cover
Scale bar
Point suspension helps to reduce transmission of vibration to instrument
Focusing adjustment rides beam on ball-bearings
Beam operated by motor-driven screw

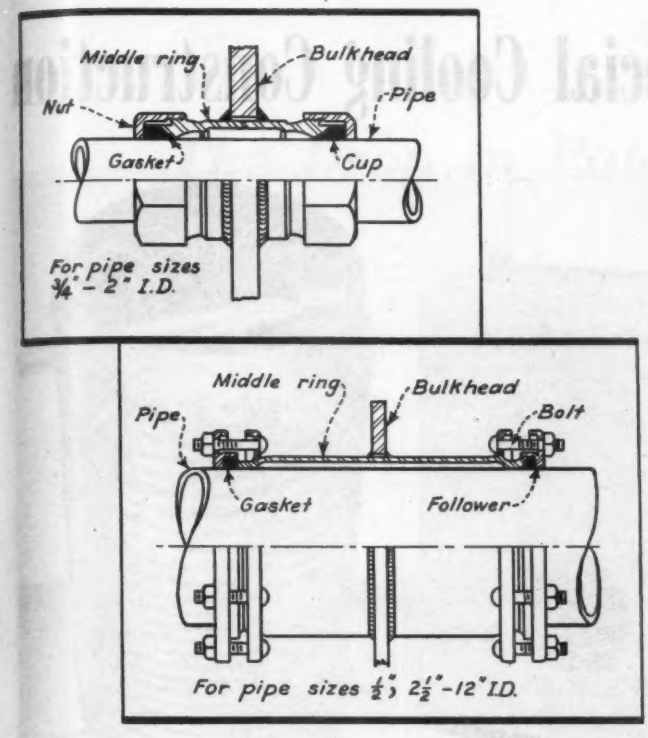

Needle bearings run on machined surface
Collimating mirror
Mount holds concave grating
Triangular inset
Stiffening blades welded in
Bridge members welded on to support cover
Bearing supports grating mount on top and beam underneath

Arc surfaces are machined about bearing center. Each instrument is, therefore, true about its own bearing center and assembly difficulties are avoided. Grating of 4-m. radius, 100 mm. long and ruled with 10,000 lines per cm. is used. Dispersion ranges from 4.8 Angstrom units per mm. at one end of the arc to 3.6 Angstrom units per mm. at the other end of the arc.

Grating Spectrograph Fabricated From Welded Sheet Steel

LIGHTNESS and rigidity were achieved in a grating spectrograph made by Bausch & Lomb Optical Company by fabricating the structure from ⅛-in. welded sheet steel. Main chassis consists of two rectangular beams welded to each other and to the arc. Traveling beam is also of welded construction. One fixed beam extends back from the slit to support the arc and auxiliary apparatus. Unit is supported by three formed and welded pedestals. Grating mount, film holder and magazine are sand castings. Weight of completed unit is less than 1,500 lb. Longest dimension of instrument is 126 in. and traveling beam is 113.5 in. long.

Beam travels across arc in 2 min. when switch on end of beam is thrown completely over. If this switch is held in halfway position, motor operates at slow speed for precise setting. Overrun is prevented by cutout switches. Shutter is operated from plate or arc positions and has a pilot light to indicate its position. Footage counter on film magazine indicates unexposed amount of film.



Bulkhead Pipe-Seal Dampens Vibration

DESIGNED to speed production of the Army's sturdy FP boats, a device for sealing pipes passing through a partition or bulkhead has been developed by the Dresser Manufacturing Company. Called a bulkhead seal, the device is essentially a stuffing box and is easily installed by using only regular equipment and an ordinary wrench.

The flexible gasket pipe-grip permits free and independent movement of the pipe thus avoiding the possibility of harmful stresses. Transmission of vibration is effectively dampened by the use of wedge-section gaskets which prevent metal-to-metal contact.

This unusual type of construction has possibilities not only for boats but also in any application where a pipe must be run through a partition.

Pressed Steel Tool Handle Replaces Aluminum

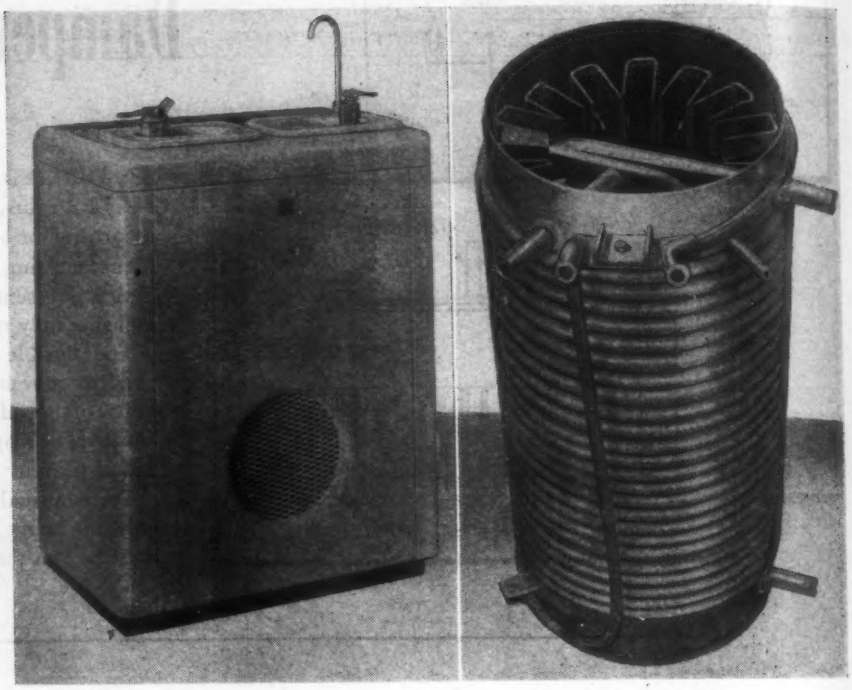
A PRESSED STEEL HANDLE for portable hand tools, designed by Glenn C. Wilhide, chief engineer, Black and Decker Manufacturing Company, represents a substitute design for material conservation that has proved its worth and will be projected into postwar models.

Prewar handles for certain portable tools were made of aluminum castings. The aluminum shortage led, at first, to a cast-iron substitute, but this was unsatisfactory from the standpoint of weight and inability to withstand rough treatment given portable tools.

The problem was met by designing handles of 18-gage hot-rolled annealed strip. The handle is made in two sections—the upper section requires nine press operations, and the lower section six operations. Assembly is performed in three operations: Spot welding the switch support; brazing a flange to the upper section; and brazing together the upper and lower sections. The handle is finished in gray wrinkle enamel. Despite additional labor required, pressed steel handle costs less.

Water Coolers Have Special Cooling Construction

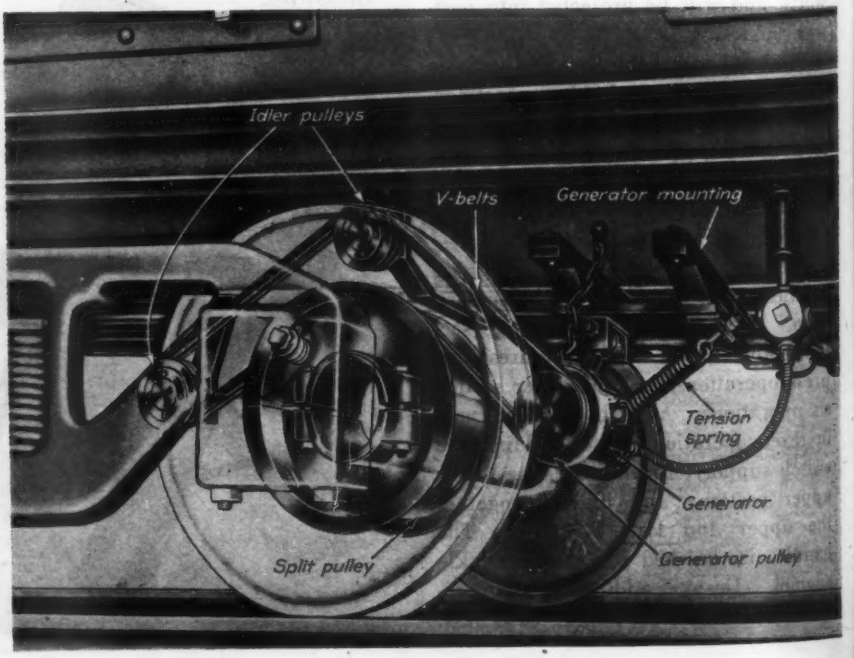
Eliminating warm-up and "wet" systems (water in refrigerant lines), and featuring a simplified method of control, Strata-Flow coolers designed by Drayer & Hanson, Inc., are entirely new in design. The shell of the storage tank is located between vertical interior fins and an external refrigerant coil. Continuous cooling action on the entire body of water in the storage tank is transmitted from the refrigerant coil through the shell to these fins. The fins prevent swirling action and confine incoming warm water supply to upper levels, eliminating mixture with water already cooled in the lower portion of the tank and thus minimizing warm-up. Since refrigerant can never come in direct contact with water, danger of wet systems is eliminated and control is non-critical. This permits use of simple controls, consisting of an automatic expansion valve and external adjustable thermostatic switch.



V-Belt Caboose Generator Drive

Two-way radio communication for railroad freight service required the development of a satisfactory generator drive to supply electric current to the train caboose. Easy servicing and minimized vibration were mandatory requirements.

The Wincharger Corporation met the requirements by designing a two V-belt drive. Either belt, which can be easily replaced in a few minutes, drives the unit. The two endless V-belts, made by the Dayton Rubber Manufacturing Company, pass over the generator pulley and a split pulley. Two idler pulleys, mounted on the caboose truck, guide the belts. A spring attached to the generator maintains tension. Jolts and vibration are dampened by mounting the generator on the caboose frame. Easy installation was made possible by connecting the split pulley to the caboose axle and driving the V-belt by its wide face rather than the angular sides.



The Drop in Patent Applications

IN A RECENTLY PUBLISHED REPORT, the National Association of Manufacturers expresses a great deal of concern over the notable decrease in patent applications during the past few years. The assumption is that fewer patent applications presages a drop in new products and a slowing in progress. This conclusion is not reasonable when the full significance of quantity of patent applications and its relation to progress is studied.

History shows that there always has been a great drop in patent applications during wars. This is natural. In wartime, national thinking is concentrated on the design of military weapons and equipment. During a war, patent applications are not made on inventions of war material.

It is also natural that fewer applications for patents on peacetime product inventions are made in wartime because of the decrease in manufacture of civilian goods. This is especially true in this war because of the almost complete suspension in manufacture of civilian goods.

Too much significance is attached to the number of patent applications. Cellar and attic inventors are most prolific during periods of prosperity. It is also true that the average worth of new patents is inversely proportional to their quantity raised to some power greater than one. The patent applications on gadgets, novelties and jim cracks flow into the patent office in an unending and ever greater stream during normal peacetimes. They contribute only confusion to our national prosperity.

The inventions that make possible industrial growth and prosperity primarily are those that stem from increased scientific knowledge and discoveries. Faraday's discovery of the generation of electricity by magnetic induction was the foundation of our vast electrical industries. Watt's success in analyzing the operation of a steam engine changed the whole industrial picture in the nineteenth century. The Wright brothers at Kittyhawk did more than merely thrill the world when their heavier-than-air machine left the ground. They established the basis for a great new scientific field in the study of aerodynamics and thereby started an unending chain of developments. Millikan's and Lee de Forrest's researches gave birth to the radio industry.

During this war there have been a great number of basic discoveries, many of them still cloaked in military secrecy. Some of them like radar, penicillin, D.D.T., the gas turbine, and rocket propulsion have been announced. Along with these new inventions, we have seen in the last few years the perfection of many production processes and new materials. No one can guess how many men have already schemed how to convert this progress into new products. When the war is over we shall see a deluge of patent applications, and the percentage of them that have genuine value will be above the average.

As we stated more than 10 years ago, there can never be a holiday in product development —until the scientist has exhausted the resources of the physical world; until the metallurgist and the chemist have made their last experiment; until the designing engineer has applied all usable knowledge, every known material, each available device—not until the mind of man ceases to function can there be a holiday in product development.

G. F. Zodenholt

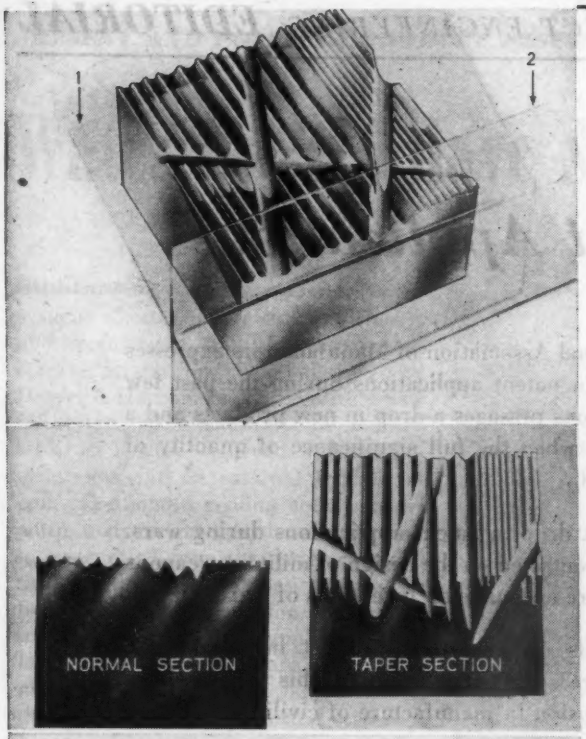


Fig. 1 — Taper section cutting plane (1) and normal section cutting plane (2) intersecting conventionalized block having surface roughness are shown in upper view. Lower views show normal section (left) and taper section (right) and serve to illustrate vertical hypermagnification (exaggerated) of taper-sectioned surface.

TAPER-SECTIONING PROCEDURE
1/4"
1"
1-1/2"
CUT OUT PIECE FROM SURFACE TO BE MEASURED
2°17'
REMOVE BACK STOP - PLACE ON JIG OF GRINDER AT 2° 17' AND GRIND UNTIL 2/3 OF UPPER SURFACE IS SMOOTH
LAY PIECE FACE DOWN ON SOFT PAPER PLACE ON SURFACE OF GRINDER AND CAREFULLY FACE OFF BACK SIDE PARALLEL TO ROUGH SURFACE TO BE MEASURED.
HOLD PIECE FACE DOWN ON ROUGE WHEEL AND POLISH GROUND SURFACE CAREFULLY.
SPECIMEN
COAT BACK SIDE WITH PLATING STOP SUCH AS ASPHALTUM AND PLATE HEAVILY WITH NICKEL - DO NOT ETCH
MOUNT SPECIMEN AND TAKE PHOTOMICROGRAPH OF TYPICAL SECTION FOR STUDY AND ANALYSIS.
FIG. 2

Measuring Methods Described For Surface Roughness Specification

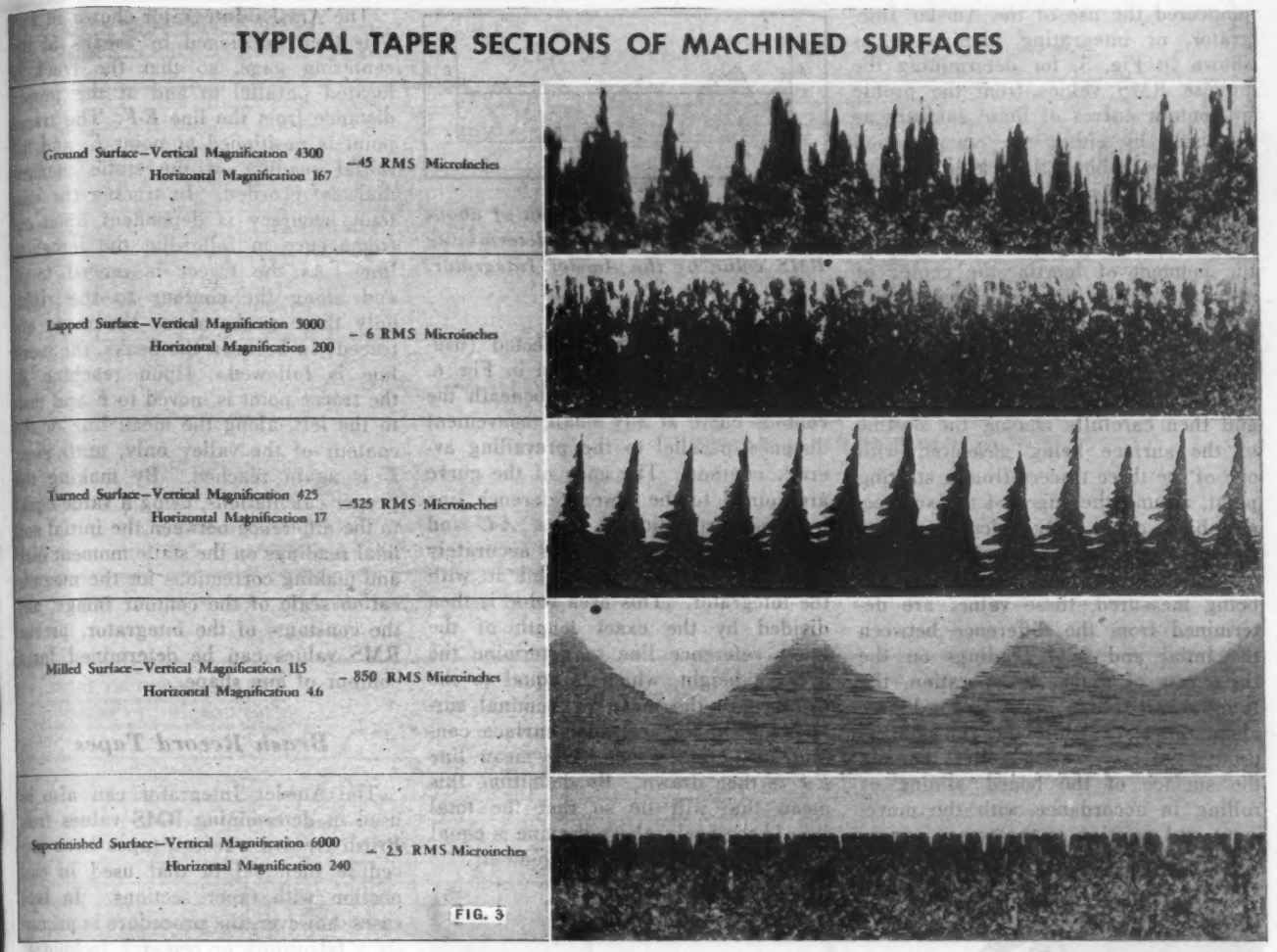
JAMES A. BROADSTON
Armament Engineer, North American Aviation, Inc.

The final in a series of four comprehensive articles on measuring and specifying surface roughness in an effort to point the way toward standardization of such procedures. The taper-sectioning technique is described along with methods for establishing defined standards through use of an Amsler Integrator, and ways of determining RMS microinch values from Brush Analyser record tapes.

TAPER sectioning, a satisfactory and reliable method of studying the surface contour of metals and of checking the accuracy of tracer point measurements, was developed by H. R. Nelson of the Battelle Memorial Institute, Dayton, Ohio, in the course of surface finish research sponsored by the Norton Company of Worcester, Mass. The technique is an accurate means of developing surface roughness standards which will conform to defined values.

The process of taper sectioning consists of cutting a machined surface at a very small angle with the plane of the nominal surface as shown in Fig. 1. The line of intersection of the plane of the cut creates an apparent magnification of the depth of the surface irregularities as contrasted to the actual surface contour. A convenient taper angle is 2 deg., 17 min.; this produces a vertical magnification 25 times as great as the horizontal.

The procedure for preparing a taper section is illustrated in Fig. 2. After



the section has been prepared, photomicrographs are taken of the area where the specimen and the nickel plate join. A study of the representative taper sections shown in Fig. 3 brings out several interesting observations: Even the finely ground surface appears to be sharp, jagged, and without pattern; the lapped surface is full of pits which have been gouged out by loose abrasive grains; the turned surface shows a definite feed pitch and a repeating pattern, resulting from the shape of the tool used; the milled surface is composed of large waves; the Superfinished surface is almost perfectly smooth, except for an occasional scratch remaining from the previous finishing operation.

These taper section photomicrographs clearly indicate that different finishing processes produce different surface patterns. As two surfaces having the same RMS roughness can feel decidedly different when tactually compared, a completely accurate comparison of surfaces requires a roughness standard gage for each basic type, as well as for each standard roughness.

Sometimes the views of taper sections or profile curves that are hypermagnified give the impression that a 90-deg. cone diamond tracer point cannot begin to follow the rough surfaces. Fig. 4 shows that if we hypermagnify the tracer point too, as shown in the right-hand view, it does not do such a bad job.

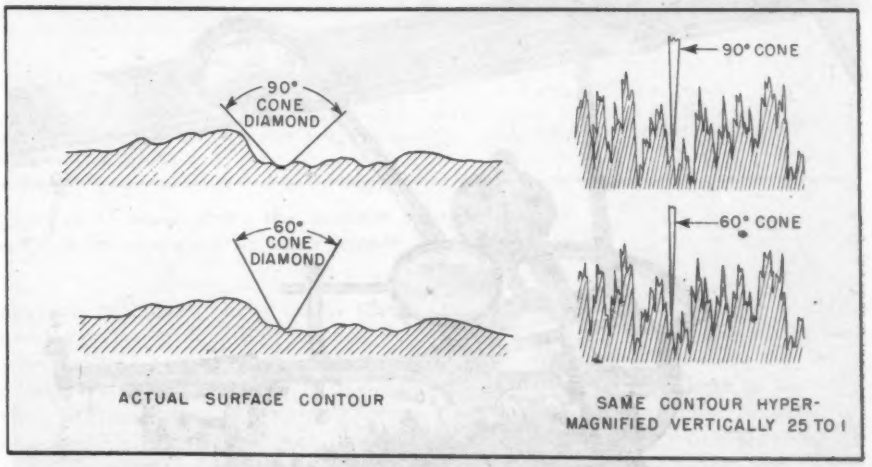


Fig. 4—Wide-angle diamond tracer points will suffice as shown in the hypermagnified view at upper right.

By definition, the RMS value is "the square root of the mean square of an infinite number of distances, measured in microinches, from the mean surface and normal to it, to points along the actual surface irregularities." (The RMS value of any irregular surface contour or profile curve can be determined by the measuring and computation method outlined in the first article of this series, page 623, October P. E.) By increasing the number of measurements taken, the accuracy of the determination can be increased. However, such a process is at best laborious.

North American Aviation, Inc., has

pioneered the use of the Amsler Integrator, or integrating planimeter, as shown in Fig. 5, for determining the precise RMS values from the profile or contour curves of these surfaces as produced by either the taper section photomicrograph or the Brush Analyzer record tape.

With an Integrator, it is possible to determine the area, the static moment, the moment of inertia, the center of gravity, and the principal axes of any irregular plane surface. This is accomplished by properly aligning the instrument, reading the intial values indicated on the "A," "M," and "J" dials, and then carefully tracing the outline of the surface being measured with one of the three tracers from a starting point, around the edges of the surface, and back again. By calculations dependent upon the design of the instrument and the scale of the surface being measured, these values are determined from the difference between the intial and final readings on the three sets of dials. In operation, the Integrator is free to move back and forth along the track while the rims of the three small integrating rollers contact the surface of the board, sliding or rolling in accordance with the movement and position of the tracer arm.

In determining the RMS value, a

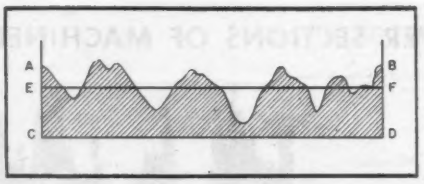


Fig. 6—Suitable trace length of about 10 in. is selected for determining RMS value by the Amsler Integrator.

suitable trace length is selected (usually about 10 in.) as shown in Fig. 6. A line *C-D* is then drawn beneath the contour curve at any small, convenient distance parallel to the prevailing average contour. The ends of the curve are joined to the lower reference line by two perpendicular lines, *A-C* and *B-D* and the area inclosed is accurately measured by tracing around it with the integrator. This area value is then divided by the exact length of the lower reference line to determine the average height, which is equal to the distance to the mean or nominal surface line of the irregular surface contour being measured. The mean line *E-F* is then drawn. By definition, this mean line will lie so that the total area of the peaks above the line is equal to the total area of valleys below it.

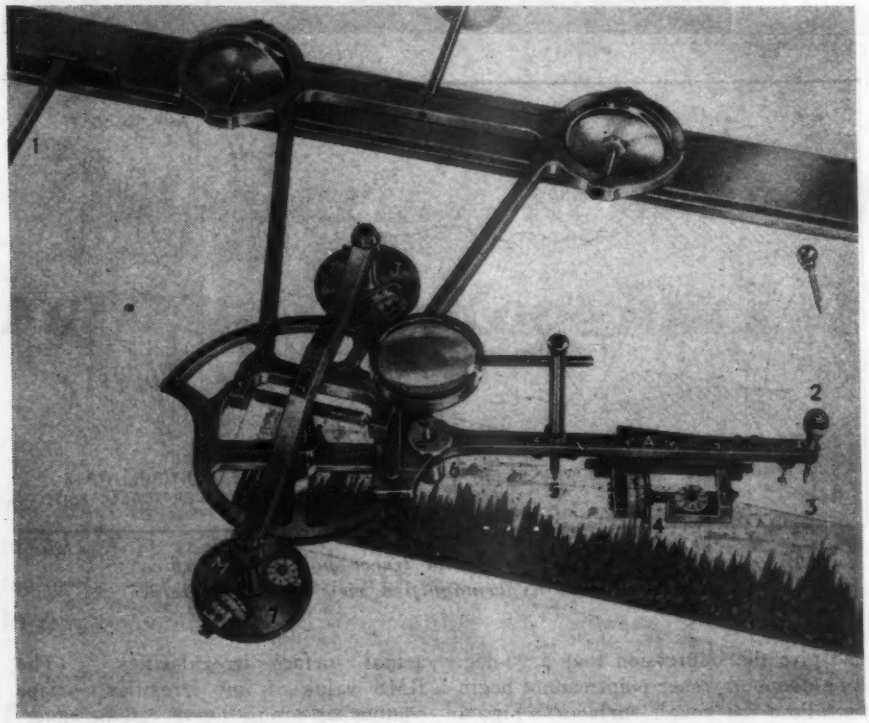


Fig. 5—The Amsler Integrator is used by North American Aviation, Inc., for determining precise RMS values from the contour or profile curves of surfaces. The instrument rolls along track on wheels in the directions of the groove. Important points on the Integrator are: 1. Centering gage; 2. operating handle; 3. tracer point No. 1; 4. area dials marked "A" used for arithmetical average microinch determination; 5. tracer point No. 2; 6. tracer point No. 3; 7. static moment dials marked "M" used for RMS determination.

The Amsler Integrator shown in Fig. 5 is then positioned by means of the centering gage, so that the track is located parallel to and at the proper distance from the line *E-F*. The tracer point is positioned at point *E*, and the initial reading of the static moment dials is recorded. In tracing the contour, accuracy is dependent upon extreme care in following the irregular line. As the tracer is moved to *A* and along the contour to the right, only those peaks above the mean are traced; in between the peaks, the mean line is followed. Upon reaching *B*, the tracer point is moved to *F* and then to the left, along the mean line or the contour of the valley only, until point *E* is again reached. By making the proper calculations, using a value equal to the difference between the initial and final readings on the static moment dial, and making corrections for the magnification scale of the contour image, and the constants of the integrator, precise RMS values can be determined for a contour of any shape.

Brush Record Tapes

The Amsler Integrator can also be used in determining RMS values from Brush Analyzer record tapes by a procedure identical to that used in connection with taper sections. In both cases, however, the procedure is primarily a laboratory or research technique; it is much too complicated for use in rapid spot checks of surface roughness.

A more rapid method of determining RMS values from record tapes is described immediately following. It has been proved that in using this method an experienced operator can make RMS determinations in approximately five minutes.

The first step is the selection of a length of Brush record tape approximately equal to a complete cycle of operation, that is, a length of tape in which the trace follows to the point where it begins to repeat itself. The repetition in the trace is caused by the slow back-and-forth motion of the tracer point over the same line of contact. A pencil line is drawn along the centerline of the tape, and 50 numbers are written along the edge of the chart, one at each "heavy" cross line as shown in Fig. 7. These numbers equal the distance measured in "small squares" from the chart centerline to the trace intersection on each of the heavy curved cross lines. Each of these values is mentally squared and the squares added together. The total is divided by the number of readings taken to find the "mean square." The square root of the "mean square" is then de-

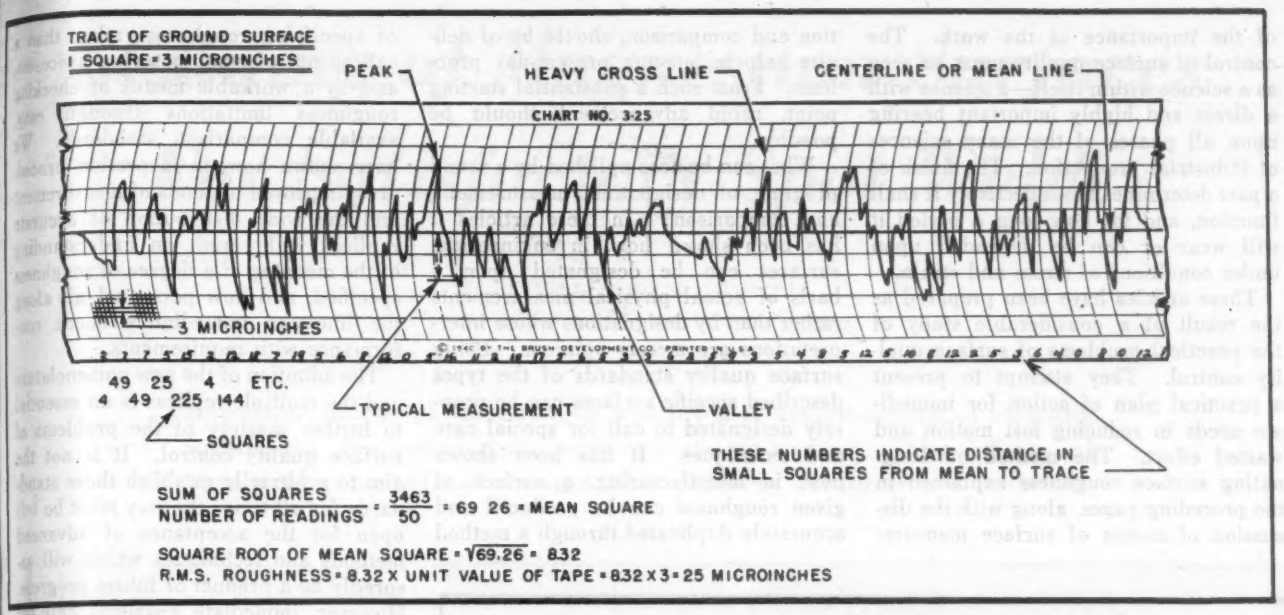

TRACE OF GROUND SURFACE
1 SQUARE = 3 MICROINCHES
PEAK
HEAVY CROSS LINE
CENTERLINE OR MEAN LINE
CHART NO. 3-25
3 MICROINCHES
49 25 4 ETC.
4 49 225 144
SQUARES
TYPICAL MEASUREMENT
VALLEY
THESE NUMBERS INDICATE DISTANCE IN SMALL SQUARES FROM MEAN TO TRACE
SUM OF SQUARES / NUMBER OF READINGS = 3463 / 50 = 69 26 = MEAN SQUARE
SQUARE ROOT OF MEAN SQUARE = √69.26 = 8.32
R.M.S. ROUGHNESS = 8.32 X UNIT VALUE OF TAPE = 8.32 X 3 = 25 MICROINCHES

Fig. 7—A Brush Analyzer record tape is used for a more rapid method of determining RMS values.

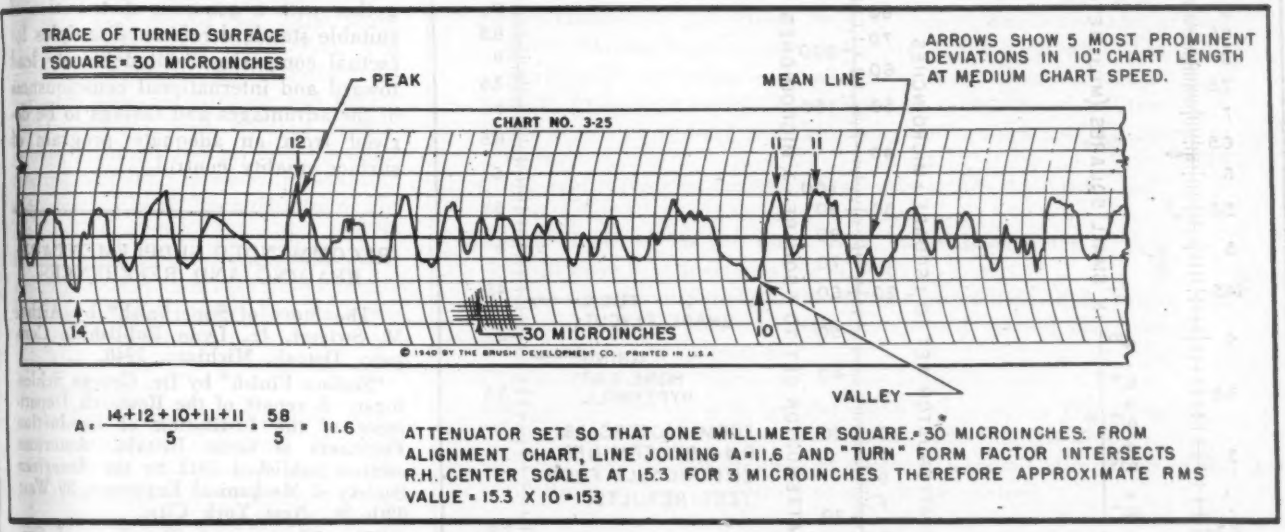

TRACE OF TURNED SURFACE
1 SQUARE = 30 MICROINCHES
ARROWS SHOW 5 MOST PROMINENT DEVIATIONS IN 10" CHART LENGTH AT MEDIUM CHART SPEED.
PEAK
MEAN LINE
CHART NO. 3-25
12
11
11
14
10
30 MICROINCHES
VALLEY
A = (14+12+10+11+11)/5 = 58/5 = 11.6
ATTENUATOR SET SO THAT ONE MILLIMETER SQUARE = 30 MICROINCHES. FROM ALIGNMENT CHART, LINE JOINING A = 11.6 AND "TURN" FORM FACTOR INTERSECTS R.H. CENTER SCALE AT 15.3 FOR 3 MICROINCHES THEREFORE APPROXIMATE RMS VALUE = 15.3 X 10 = 153

Fig. 8—A chart record is made from the surface being measured. Approximate roughness estimates can be made rapidly by this method.

termined. As the microinch value of each "small square" is known from the magnification used in making the trace (the attentuator setting), the "mean square" value, multiplied by the unit value of the "small square," is the RMS value for the surface.

Approximations From Tapes

North American Aviation has also developed a method of making rapid approximations of RMS values from Brush Analyser tapes by means of the special alignment chart.

A chart record, such as the one shown in Fig. 8 is made from the surface being measured, and a length equal to one complete cycle of the tracer arm is marked off. The center line-to-peak distance "*P*" of the five most pronounced deviations (in terms of small chart squares millimeters) is then determined by inspection. From this, the average value "*A*" is found. A straightedge is positioned on the alignment chart of Fig. 9, so as to join the "*A*" value on the left-hand scale with the proper form factor on the right-hand scale. Considering the magnification used in making the tape, the proper RMS value can be selected at the intersection of the line and center scale.

This method of RMS computation has been developed only as a convenient procedure for making approximate roughness estimates rapidly, and is not as accurate as the more involved computation procedures already described.

The full story of surface control is just beginning to be written. Some small beginnings are underway; some small progress has been made. The full job still lies ahead—a work for the future. Whether it shall be the near future or in time still quite far off, depends upon the sincerity of purpose, the enthusiasm, and the willingness to cooperate and to compromise with which all those concerned with the art of surface quality control set about tackling the many problems. The full attainment of advancement in surface quality control depends, too, upon a clear realization that a great many of the problems now encountered in the operation of precision equipment can be traced directly to improper surface finish.

First must come the recognition of a definite goal—a cognizance of clear-cut objectives. Such recognition must certainly include a fuller understanding

of the importance of the work. The control of surface quality must be seen as a science within itself—a science with a direct and highly important bearing upon all phases of the many sciences of industrial production. The finish of a part determines how effectively it shall function, and for how long a period it will wear or can be depended upon under conditions of stress and strain.

These articles have been prepared as the result of a considerable study of the practical problems of surface quality control. They attempt to present a practical plan of action for immediate needs in reducing lost motion and wasted effort. The method of designating surface roughness explained in the preceding pages, along with the discussion of means of surface mensuration and comparison, should be of definite help in meeting present-day problems. From such a substantial starting point, rapid advancement should be possible.

What can be accomplished by a sound program of designation, measurement, and comparison? In these articles it has been shown how, in engineering, surfaces can be designated upon a basis of actual physical measurements rather than by designations whose interpretations are merely opinions. Using surface quality standards of the types described specific surfaces can be properly designated to call for special care and techniques. It has been shown how, in manufacturing, a surface of given roughness can be produced and accurately duplicated through a method of specifying roughness rather than a calling out of manufacturing processes, and by a workable means of checking roughness limitations through easy, available comparison standards. We have shown how, in inspection procedures, improved methods of measurement and the wide distribution of accurate replicas will permit an understanding of the meaning of a degree of roughness specified, and how personnel all along the line can immediately check conformance with requirements.

The adoption of the new nomenclature and the multiple replicas is an essential to further mastery of the problems of surface quality control. It is not the aim to arbitrarily establish these standards for all time; the way must be left open for the acceptance of advanced methods and techniques which will assuredly be a product of future progress. However, immediate problems call for solution, and it is felt that the nomenclature discussed in these pages together with a generous distribution of suitable standard reference samples for tactual comparison will definitely lead toward and international consciousness of the advantages and savings to be derived from an adequate program of surface quality control.

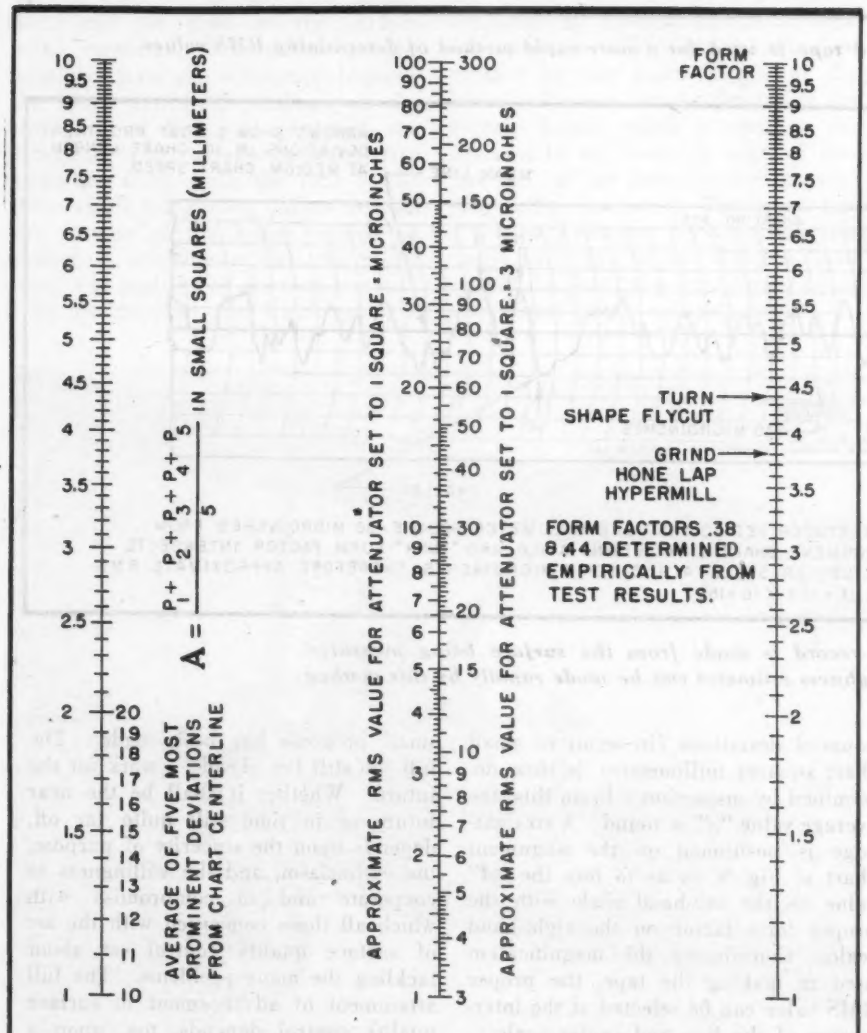

AVERAGE OF FIVE MOST PROMINENT DEVIATIONS FROM CHART CENTERLINE
A = (P1 + P2 + P3 + P4 + P5) / 5 IN SMALL SQUARES (MILLIMETERS)
APPROXIMATE RMS VALUE FOR ATTENUATOR SET TO 1 SQUARE = MICROINCHES
APPROXIMATE RMS VALUE FOR ATTENUATOR SET TO 1 SQUARE = 3 MICROINCHES
FORM FACTOR
TURN SHAPE FLYCUT
GRIND HONE LAP HYPERMILL
FORM FACTORS .38 & .44 DETERMINED EMPIRICALLY FROM TEST RESULTS.
WHEN ONE SQUARE ON RECORD TAPE EQUALS 10,30,100 OR 300 MICROINCHES, MULTIPLY RMS VALUES GIVEN BY 10 OR 100 AS REQUIRED TO MAKE CORRECTION FOR ATTENUATOR SETTING OF BRUSH ANALYSER AMPLIFIER.

Fig. 9—This alignment chart for RMS computation was developed as a convenient procedure for making approximate roughness estimates rapidly.

RECOMMENDED SUPPLEMENTARY READING AND REFERENCES

"The Story of Superfinish" by Arthur M. Swigert, Jr., Lynn Publishing Company, Detroit, Michigan, 1940.

"Surface Finish" by Dr. George Schleinger. A report of the Research Department of the Institution of Production Engineers of Great Britain. American edition published 1942 by the American Society of Mechanical Engineers, 29 West 39th St., New York City.

"The Physics and Chemistry of Surfaces" by Neil Kensington Adam, Oxford University Press, London, England, 1941.

"Technische Oberflachenkunde" (Evaluation and Measurement of Surface Quality) by Gustav Schmalz. Published by Julius Springer, Berlin, 1936.

"Development of Standards for Army Ordnance Finishes" by Mary R. Norton, *Mechanical Engineering*, October, 1942.

"Surface Contour by Taper Sectioning" by H. R. Nelson, *American Machinist*, August 6, 1941.

"American Standards Association Bulletin, B-46" on Surface Roughness is now a tentative standard. It is hoped that the final approved standard will soon be published. Copies obtainable from the Association at 30 cents each, 29 West 39th St., New York City.

"Society of Automotive Engineers Aeronautical Standard AS-107" is obtainable from the Society at 29 West 39th St., New York City.

"National Aircraft Standards Committee" Surface Roughness Standard NAS 30, obtainable from the office of the National Chairman, NASC, care of Aeronautical Chamber of Commerce, 610 Shoreham Bldg., Washington, 5, D. C.

Cleaning of Magnesium Surfaces For Satisfactory Spot Welds

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Important phases of various tests which led to establishment of cleaning techniques for magnesium surfaces are presented. The effects of spot welds on surfaces cleaned with different solutions are reviewed.

UNDER the demands for wartime production of Flying Fortresses and Superfortresses, Boeing Aircraft Company was faced with the necessity of finding manufacturing methods that would not only adapt themselves to mass production, but would also give to the manufactured parts the required strength and weight characteristics. Spot welding seemed to have many advantages over the older riveting methods; however, in adapting spot welding to the manufacture of aircraft parts, certain difficulties had to be overcome. Because satisfactory spot welds in magnesium base alloys cannot be made without proper cleaning of the surfaces to be welded, extensive investigation was made to discover the most effective cleaner.

Results of this investigation, which was confined to Dowmetal M, magnesium with 1.5 percent manganese, showed that hot chromic acid or chrome-nitric acid are the most effective of the chemicals listed in Table I and that high quality welds can be made after cleaning with one or the other.

Suitability of the various cleaners was determined by three factors: (1) The etching effect on the base metal, (2) the cleanliness of the surface, and (3) the shear value of the spot welds as determined on the Olsen machine.

The etching effect was determined by observing the reaction of the cleaner on the metal and the appearance of the cleaned metal. Chromic acid was the only cleaner that removed the protective oxide coating without corrosion and that caused no dimension change. Reaction with the metal, which is usually vigorous, makes the time of immersion in most cleaners critical if serious corrosion is prevented. If cleaners dissolved the surface coating at an equal speed all over the surface, timing might be practical, but the speed of oxide removal varies at different places on the surface because of differences in thick-

Effects of Various Cleaners on Magnesium

Gasoline, Turco L595, Union solvent No. 1, ethyl alcohol, acetone, ethyl acetate, and carbon tetrachloride have no cleaning effect.
Metso, Oakite, No. 20, Metso No. 99, ammonium hydroxide, ammonium chloride, sodium tetraphosphate, sodium tetraphosphate plus nitric acid, and phosphoric acid have slight cleaning effect.
Sodium hydroxide attacks base metal in concentrated solution.
Sodium tetraphosphate plus chromic acid makes surface green in color.
Citric acid is poor on coating, vigorously etches the base metal.
Mercury No. 15 produces shiny surface.
Hydrochloric acid is fair on coating, etches base metal.
Hydrofluoric acid produces slight etch.
Nitric acid and sulphuric acids are fair on coating, etch base metal.
Nitric-sulphuric is fair on coating, vigorously etches base metal.
Acetic acid is fair on coating.
Chrome-sulphuric acid turns surface brassy in color.
Chrome-phosphoric acid and chrome-acetic acid are fair cleaners.
Chromic acid and chrome-nitric acid are excellent cleaners.
Organic solvents and alkali-type cleaners were all eliminated in the preliminary test for failure to attack the coating.

Table I—Optimum Operating Conditions For Magnesium Cleaners

Name of Method	Concentration (To make 1 liter)	Immersion Time, min.	Temp. Range Deg. F.
Chrome-nitric acid	100g CrO_3 & 10 cc HNO_3	1–2	190–212
Chromic acid	180g CrO_3	3–6	190–212
Chrome-phosphoric acid	100g CrO_3 & 10 cc H_3PO_4	1	180–212
Chrome-acetic acid	100g CrO_3 & 5 cc H Ac*	1/2–1	180–212
Acetic acid	5 cc H Ac*	1/2–1	70
Sulphuric acid	5 cc H_2SO_4*	1	70
Nitric acid	10 cc H NO_3*	1	70
Nitric-sulphuric acid	80 cc HNO_3* & 20 cc H_2SO_4*	20–30 1/3–1/2	70

* All acids were C. P. and concentrated

nesses or densities of the coatings.

Cleanliness of the surface was determined by measuring the electrical contact resistance, it being assumed that the lower the resistance, the cleaner the surface. Electrode pressure was 1,000 lb. Average resistance readings in microhms for the best cleaners were:

Before cleaning	341.8
Chromic acid	15.3
Chrome-nitric acid	15.8
Chrome-phosphoric acid	30.2
Chrome-acetic acid	36.2
Wire brushed	54.6

Wire-brushed specimens were measured within 1 hr. after brushing. Surface coatings can be removed mechanically but a dark oxide coating forms rapidly, which prevents satisfactory spot welding.

Shear strength of spot welds was obtained by welding two magnesium strips at one spot using aluminum alloy machine settings, then measuring the stress applied at right angles to the surface of the spots required to shear the spot or material. Electrode pressure and electric current were approximately the same as required for 24ST Alclad of the same gage. Time cycles were necessarily shorter. Table II gives settings on the spot welding machine. Shear strength of weld spots on specimens cleaned by the four best cleaners was determined in an Olsen testing machine. Shear values obtained on specimens cleaned by the two best methods are 180 percent of the Army Air Corps minimum in Specification 20011. This minimum for 0.051 in. thickness is 267 lb. Average results of shear tests in lb. per single spot are as follows:

Chromic acid	449
Chrome-nitric acid	498
Chrome-phosphoric acid	474
Chrome-acetic acid	558

Spot welds on specimens cleaned by chromic acid had excessive penetration, some spitting occurred, spots were circular, and four slugs out of ten pulled out. Specimens cleaned by chrome-nitric acid all sheared except one, penetration was good, spots were circular, and there was little spitting. Specimens cleaned by chrome-phosphoric acid had excessive penetration, spots were non-circular, some spitting occurred, and six out of ten slugs pulled out. Welded specimens cleaned by chrome-acetic acid had excessive penetration, non-circular spots, and spitting occurred.

General conclusions of these tests favored chromic acid because of its excellent and uniform cleaning power without corrosion and dimensional change. However, chrome-nitric acid acts faster, is cheaper and a little more powerful than chromic acid. It etches the base metal only slightly if properly controlled and is, therefore, recommended as an alternate cleaning material. Since the tests were confined to a single magnesium alloy the results are not considered conclusive for other alloys. It is possible that further tests would show that the immersion time in chrome-nitric acid solution could be increased by lowering the temperature or by other methods.

Northrop Aircraft, Inc.

Typical welded assemblies of magnesium parts.

American Magnesium Corporation

Magnesium floor sections are assembled by spot welding.

Table II—Settings on Spot Welding Machine

Sciaky Machine Model PMCO2–S4

Throat depth	34 in.
Arm spacing	12½ in.
Electrodes	5/8 in. dia. and 2 in. radius curvature
Tome blocks	Nos. 3 and 4 (0.04 sec. current time)
Number of poles	4
Max. current relay setting	90
Pressure	Constant
a. No. of cylinders	1
b. Gage pressure	46
c. Electrode pressure	575 lb.
Time delay before charging	8 cycles
Recompression time	20 cycles
Voltage	Low

Production Considerations In Engineering Design

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Aims of production design engineers, production considerations in redesign, possibilities for elimination of close limits and small clearances, examples of redesigns and results in economy and simplicity of parts designed to simplify fabrication are outlined.

STARTING with a sound basic design, the aim of production design engineering is to modify or simplify the proposed product if possible to facilitate its manufacture without sacrificing strength or functional efficiency. Basic factors are:

1. Simplification.
2. Practicability of assemblies and installations.
3. Elimination of close limits and clearances.
4. Use of existing parts and standards.
5. Use of readily available materials; standard dies, jigs, fixtures; and machine tools.
6. Serviceability.

Production design involves adhering strictly to established and proved principles of manufacture. In this respect it should be noted that the functional designer is prone to seize on nebulous or partially developed processes and incorporate them into a new design without sufficient facts to justify their use. Thus, a burden is placed on manufacturing personnel not only to develop a new product, but at the same time to develop new processes without a resultant delay in production. Development and research are absolutely essential in a progressive company but such research must be proved before incorporation in design.

Design simplification may be influenced in several ways by anticipated effects in more than one department. From the shop standpoint, fewer parts can mean less stock handling, records and space, and increased production. Importance of the cost of stock records is shown by the fact that 60 percent of parts manufactured for a typical airframe cost more for the "paper work" than for the actual fabrication and assembly operations. From an engineering standpoint, fewer parts can mean fewer drawings, lighter structure, lower cost product, and elimination of critical materials.

Examples of parts that illustrate these advantages are of such great variety that only a few are included here.

The practicability of assemblies and installations is affected by the design or style of the machine and by such factors as size of contract, factory floor area, including sub-contractors; assembly methods, tooling time, required rate of production, size of machine or structure, materials to be used in fabrication, and available manpower.

If an entire structure is constructed in one massive complicated jig, crowded working conditions result. Sub-assemblies permit use of small, simple jigs for each component, one mating jig, and avoid congestion. Tooling must permit interchangeability between identical sub-assemblies.

On any contract of reasonable size, the greatest cost incurred in the manufacture of that contract will be for the tools required to fabricate the detail parts and assemble them into complete units. This cost is not as variable as one might suppose, but can be generally estimated as a definite fixed percentage of the total cost.

If a manufacturer uses so-called cheap tooling on a fairly sizeable contract, he inevitably finds that the amount of labor expended on reworking such tooling to keep it in production, the time lost in struggling with makeshift or bootleg tooling, and the manual labor used in hand finishing parts to fit into the various assemblies, will in the long run more than equal the cost of starting out with tooling designed and built to the soundest of production principles.

The breakdown of a large unit into small sub-assemblies requires close cooperation with the tooling design department to determine the most desirable sizes and shapes for small component parts. For example, if a part is to be spot welded, it must be determined whether the part can be inserted readily between the electrodes of a spot-welding machine, or whether it should be broken down into two or three smaller parts to facilitate the work of machine operators.

Similarly, if a part is to be riveted, a decision is first reached as to whether or not a riveting team can work on it with maximum comfort. If the problem can be solved by creating a new jig or fixture to hold the part during fabrication and assembly, the tooling department does so. If not, the breakdown of the part must be simplified to improve working conditions.

This breakdown into sub-assemblies must reduce elapsed over-all time without sacrificing weight and strength. The smaller the breakdown, usually the greater the number of fastening operations. If these are considerable in number, the temptation may be to reduce the number of attachments, which usually complicates the joint and may actually involve more over-all time. A compromise is therefore necessary, and if the design permits assembly and attachment in only one or two planes, and parts can be installed in sequence rather than a number of parts at one time, or adjustable members can be incorporated, simplicity of operation for the workmen-results.

Bench assemblies, which are complete units that can be placed on a structure or machine with a minimum of clamping or bolting, should be used whenever possible. Typical bench assemblies for an airplane are: Power turrets, cowl flaps, ammunition boxes, engine control stand, landing gear units, landing light assemblies, plumbing lines, cockpit inclosures, entrance ladders, conduit lines, flight control tabs, instrument panel complete with instruments, flare chutes, electrical and radio control boxes, stowage boxes.

These and similar units for final

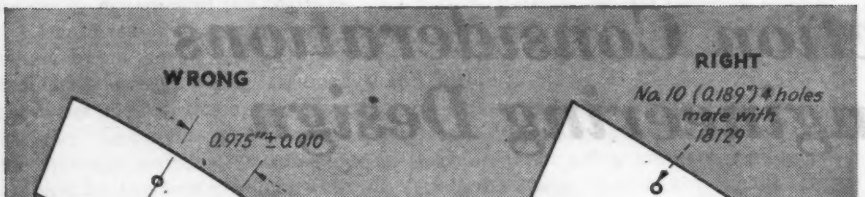


Fig. 1—Coordination instead of close tolerance is sometimes the answer to an assembly problem. Holes in the two parts might be drilled together.

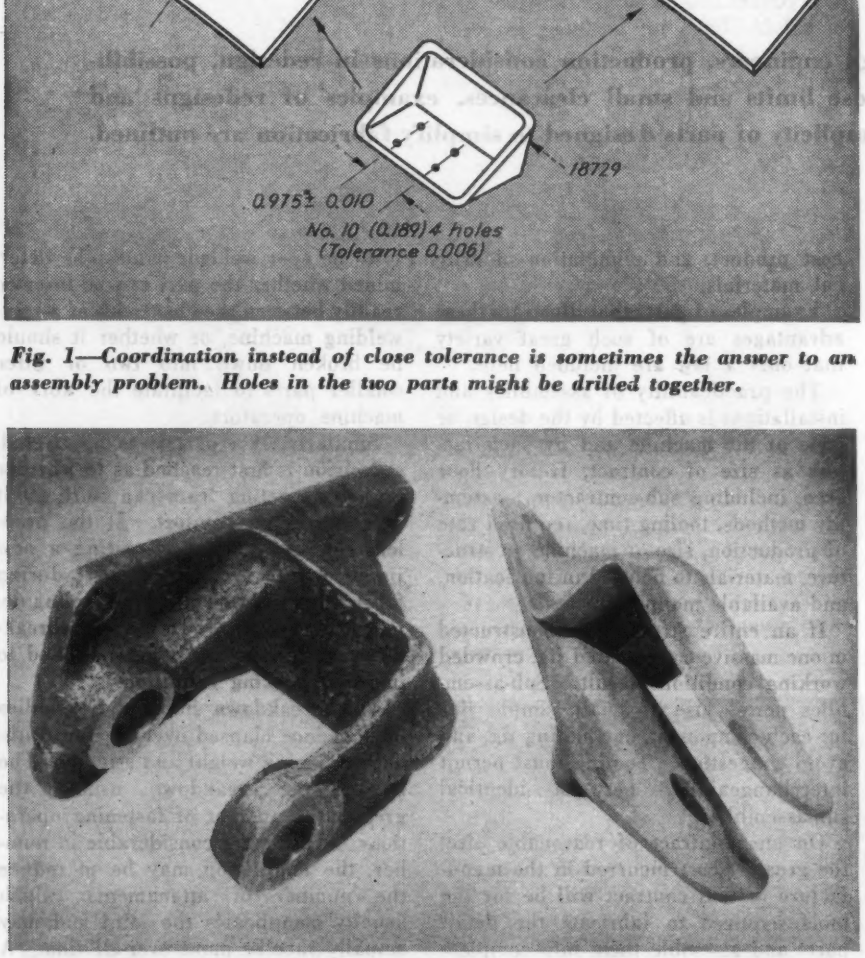


Fig. 2—Typical example of a redesigned bracket for which stamping is a more satisfactory production method for quantities required and service qualities.

assembly installations should not require welding, fitting, filing, riveting, reaming, tapping or any other similar operations that should be done in fabrication departments.

Any other machine can be broken down similarly, the important items to watch being line flow of materials, stationing of assembly operations, and avoidance of duplicate tooling. The breakdown should permit a minimum stock of material and purchased items. Proper stationing permits the greatest use of floor area and prevents too many operators in one area at one time. The need for duplicate tooling usually indicates a bottleneck created by faulty breakdown, which is too great in some instances and too small in others.

Close dimensional limits and small clearances can often be eliminated by the following means:

1. The initial or basic dimension should be the exact dimension that would be used if it were possible to work without tolerances. Tolerance should be set in the direction in which variation will cause least harm (unilateral system). When a variation in either direction is equally harmful, the limits should be of equal amount in both directions (bilateral system).

2. The initial clearance, or allowance, between operating parts should be as small as the operation of the mechanism will permit. Maximum clearance should be as great as the proper functioning of the mechanism will permit. Under no conditions should an interference fit between functional parts be tolerated.

3. It is highly desirable that a common plane or reference point be used for all dimensions, not only for detail parts but for sub-assemblies also. This is of special importance from an inspection and tooling standpoint.

It facilitates the development of masters and checking fixtures and assists the tooling department in working to the same locations in as many operations as possible. Where interchangeability requirements are rigid, the design and dimensions must usually permit full coordination of attaching and mating points. If the minimum possible coordination between tools is not considered, additional hand operation in assembly will be necessary.

Sheet metal parts are elastic, have springback and local distortion. The purpose of using a close tolerance machined part will be made ineffective if irregularities of the surrounding structure are not taken into consideration by the designer. Coordination, as illustrated in Fig. 1, instead of close tolerances is sometimes the answer to an assembly problem.

4. The "opening up" of machining tolerances will increase the number of parts that can be produced per manhour, as indicated by the accompanying curve.

5. Standards for cylindrical fits and tolerances can effect appreciable savings in costs if tables, such as that on p. 858 are used. Tables incorporating various classes of fit such as free running fits, medium running fits, snug fits, and press fits, are used by Lockheed engineers. These tables regulate hole size increments, and thus eliminate the use and stocking of special reamers, special ring and plug gages.

A table of loose fit drill holes, and their application, given on p. 856 and 857 for use with Army-Navy standard bolts and clevin pins eliminates the need for reamed holes in many instances. Loose fit drill holes, which give a clearance of approximately 0.030 in. diameter, are specified for tension applications whenever alignment does not require a closer fit. They are used for such applications as attachment of electrical junction boxes and clamp blocks to the air frame. These tables also give close fit drilled holes for AN bolts, which are also used.

Reamed holes are used with bolts only when absolutely necessary, and then only with the National Aircraft Standard ground close-tolerance bolts. Reamed hole tolerances permit the use

of standard reamers, eliminate selective fitting, and give maximum life. All sizes give a clearance fit with NAS bolts.

To allow for adjustment in a given direction when a loose fit drilled hole in sheet metal and castings would allow insufficient movement, standards on slotted holes have been established. These slotted holes can be used in secdary and non-structural applications.

Another step toward wider tolerances was achieved by greater use of class 2 fits in standard 60-deg. screw threads. Except for structural joints and for stud designs, a class 2 fit is specified for all thread applications. Fig. 3 illustrates the small gain to be made by using class 3 fits.

6. An important rule to remember is "always allow adequate clearance between movable and fixed parts." This fact was overlooked in the original design of a wheel well for one airplane. Because of tire growth, the landing gear would occasionally stick in the up position. In other instances the possibility of interference is more obvious.

In order to keep inventories and floor space to a minimum it is desirable to design with materials currently being stocked.

Careful attention must be given to these stocks so that a full range of basic sizes for the most used materials is available. Every attempt should be made to eliminate materials used in only a few sizes and conditions, and which have physical properties closely approaching those of another stocked material. The cost of extra operations to remove metal is a factor to consider here. No approval should be given to utilize a new material in a design until its physical properties, corrosion resistance, formability, and other limitations have been thoroughly tested and established.

To avoid expensive tooling programs, designers should try to use existing standard dies and parts. Every design utilizing gussets, clips, brackets, and similar items should be examined for the possibility of using standard parts. Records must be made of such parts, and the tooling branch advised of the usage so that high production tooling can be designed, built, and maintained. Keeping down the cost of a product is directly proportional to the means used to make the component parts of that product.

Labor costs per hour vary in different departments and the relation of the amount of labor per unit of product varies tremendously in different plants. For this reason, equipment, methods, and supervision are most important and the labor and departmental wage rates may be secondary.

In cost estimates, labor is divided in two elements: (1) Set-up labor and (2) production labor. Set-up varies widely and includes getting tools, blueprints, materials, checking first part and sometimes waiting for jobs. Large draw press dies may require an hour or more for setting up, whereas other factory operations may require but a fraction of a minute for set-up.

Set-up time is spread over the number of units produced in any one lot or before the set-up is torn down. Obviously, set-up costs are influenced by length of run. It also follows that the number of units to be manufactured has an important bearing on this element of cost.

The design engineer plays an important part in the reduction of set-up costs. First, simplicity of design will eliminate some parts altogether, and second, parts almost alike can often be made interchangeable. Set-up changes are thereby completely eliminated or spread over large quantitives with resultant decrease in unit costs.

The second element of labor costs, or production labor costs, represents the

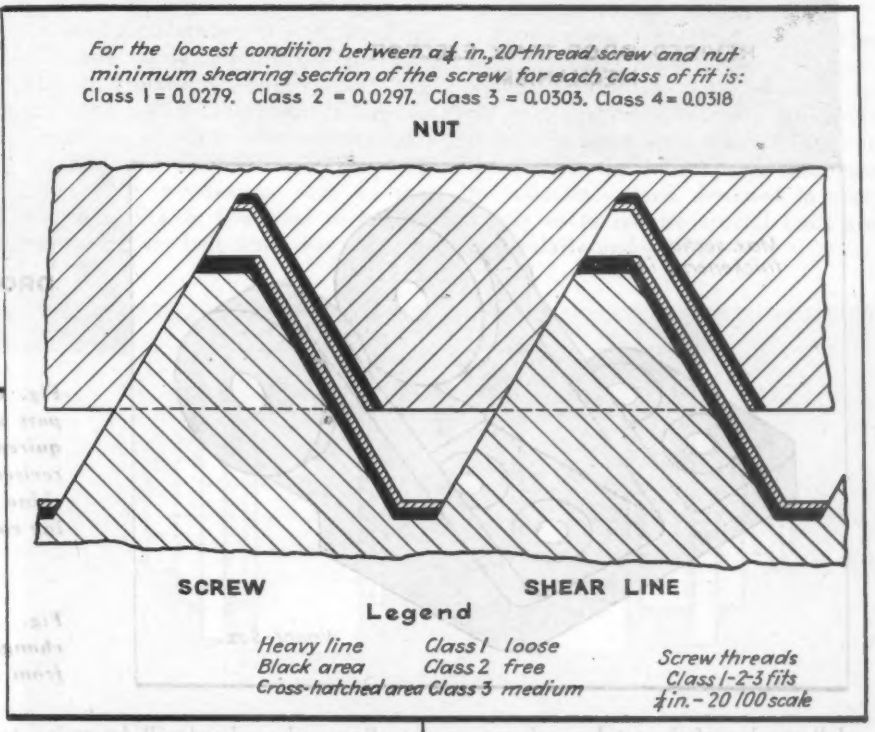

For the loosest condition between a ¼ in.,20-thread screw and nut minimum shearing section of the screw for each class of fit is:
Class 1 = 0.0279. Class 2 = 0.0297. Class 3 = 0.0303. Class 4 = 0.0318
NUT
SCREW
SHEAR LINE
Legend
Heavy line Class 1 loose
Black area Class 2 free
Cross-hatched area Class 3 medium
Screw threads Class 1-2-3 fits ¼ in. - 20 100 scale

Fig. 3—Small gain is made in using class 3 fits instead of class 2 fits in standard 60-deg. screw threads.

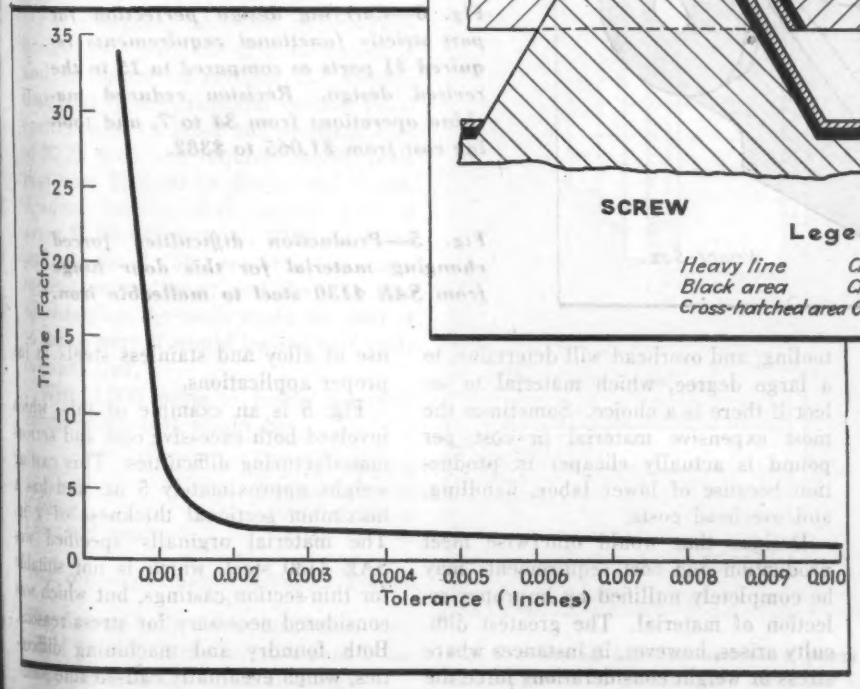


Fig. 4—More parts per man-hour can be made by "opening up" machining tolerances to 0.002 in. or more.

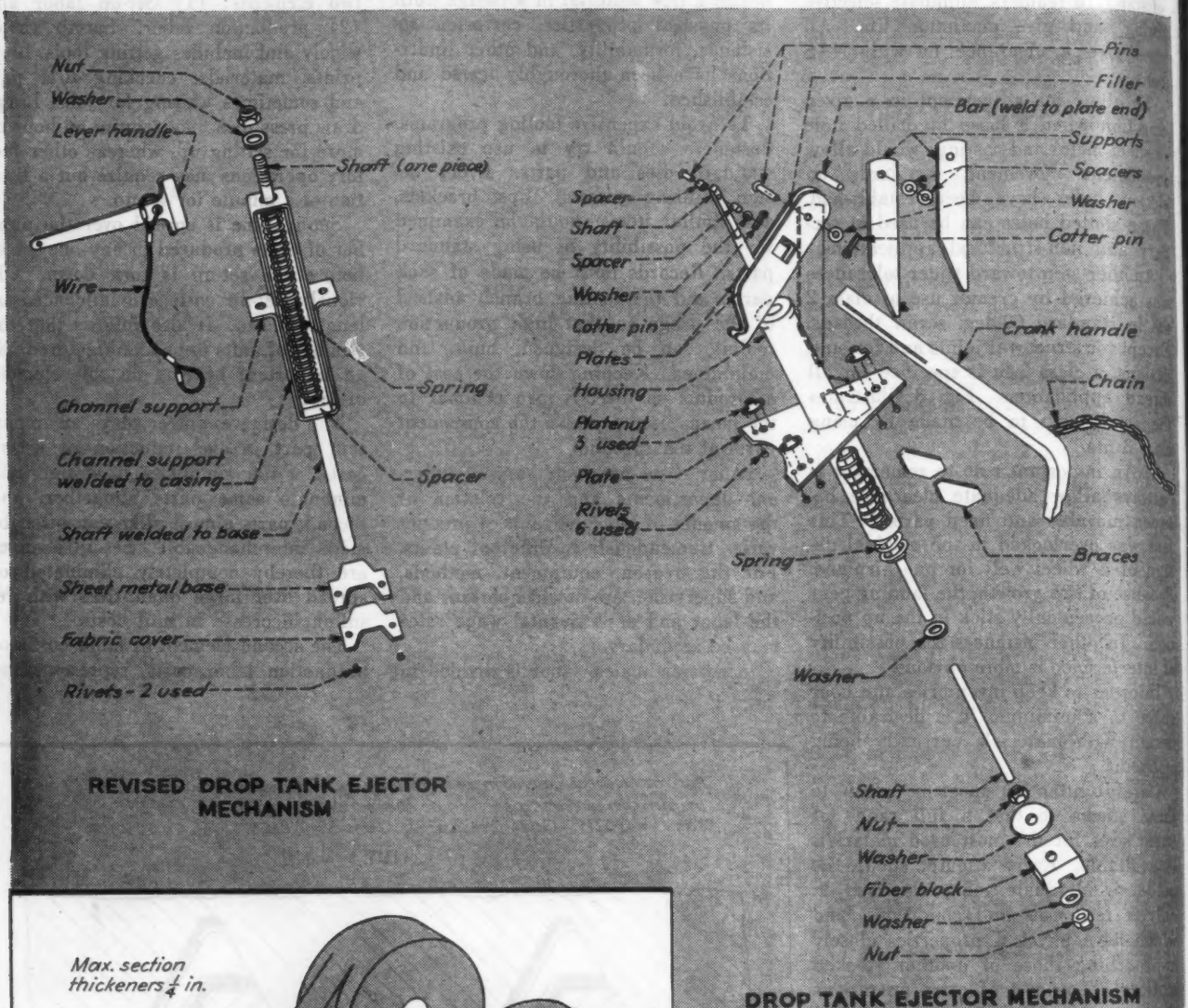


Fig. 6—Carrying design perfection far past strictly functional requirements required 41 parts as compared to 15 in the revised design. Revision reduced machine operations from 34 to 7, and tooling cost from $1,065 to $382.

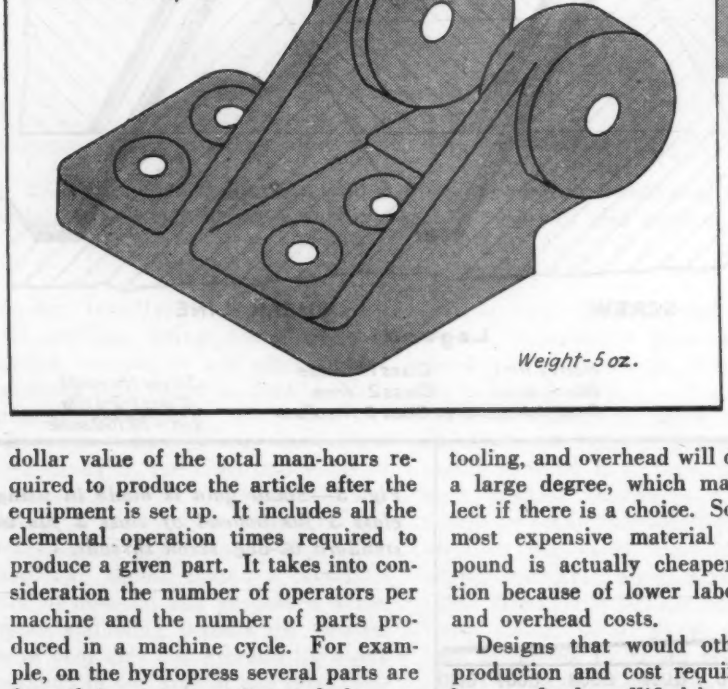


Fig. 5—Production difficulties forced changing material for this door hinge from SAE 4130 steel to malleable iron.

dollar value of the total man-hours required to produce the article after the equipment is set up. It includes all the elemental operation times required to produce a given part. It takes into consideration the number of operators per machine and the number of parts produced in a machine cycle. For example, on the hydropress several parts are formed in one operation and the machine can be manned by as many as six men.

The total cost of the labor, material, tooling, and overhead will determine, to a large degree, which material to select if there is a choice. Sometimes the most expensive material in cost per pound is actually cheaper in production because of lower labor, handling, and overhead costs.

Designs that would otherwise meet production and cost requirements may be completely nullified by improper selection of material. The greatest difficulty arises, however, in instances where stress or weight considerations force the use of alloy and stainless steels in improper applications.

Fig. 5 is an example of this, which involved both excessive cost and serious manufacturing difficulties. This casting weighs approximately 5 oz. and has a maximum sectional thickness of ¼ in. The material orginally specified was SAE 4130 steel, which is not suitable for thin-section castings, but which was considered necessary for stress reasons. Both foundry and machining difficulties, which eventually caused line short-

ages and necessitated design reconsideration, were encountered. A change in material to cast malleable iron eliminated foundry and machining difficulties and satisfied stress requirements without dimensional change. By correction of an improper material specification, the cost of producing this part was reduced.

Overhead is a very real cost to the management and is the most important feature in the consideration of cost. The method of distributing this overhead varies among different companies. Overhead at one plant is based on fixed charges for every hour of direct labor in each department. Percents, hourly rates, and other systems are also used.

The cost of dies, jigs, and fixtures are important factors in the cost of parts. One rule for amortizing tooling should be strictly adhered to, namely write off the tooling on the contract for which it is used. If a contract calls for 350 machines, write it off on that contract.

Since it is possible to spend several hundred dollars on a specially designed die or fixture, it is necessary to determine whether modifications in design will enable building the part with standard tooling or at less expense by another method. Design that requires expensive tooling should be proved whenever possible to prevent the possibliity of scrapping an expensive die at a later date.

While it is frequently possible to suggest design improvements that save manufacturing time or material, it is not always true that such changes, if effected after tool construction, will produce a saving sufficient to carry the cost of new or reworked tools.

For example, take two hypothetical designs of a part, the original design *A* and an improved revision *B*. Assume that part *A* uses material costing $0.30 each, involves a labor and overhead cost of $0.25 each, and requires special tools that cost $500.00 to design and build. Assume further that revised part *B* saves $0.05 on material, $0.10 on labor and overhead, but requires the same tooling expenditure; and that the cost of changing the tools made for part *A* to make part *B* would be one-half their original cost.

With 1,000 parts to build, the total comparative cost would be:

	Part A	Part B
Material	$300.00	$250.00
Tooling	500.00	500.00
Labor and overhead	250.00	150.00
Total cost—1,000 parts	$1,050.00	$900.00

The figures indicate a maximum saving of $150.00 if the improvement is incorporated on the original design.

But assume that the improvement in design is not effected until 100 parts have been built:

Original tool cost—Part *A*	$500.00
Material—100 of part *A*	30.00
Labor and overhead—100 of part *A*	25.00
Rework of tools to make part *B*	250.00
Material—900 of part *B*	225.00
Labor and overhead—900 of part *B*	135.00
Total cost of 1,000 parts	$1,165.00

From the foregoing it is evident that an increase in total cost may result from poorly considered redesign after original tools are complete and manufacture commenced. This difference is readily traceable to the additional expenditure required to rework or replace tools. The figures used are indicative of the problems involved in evaluating the burden imposed by tool rework.

Examination of a design for the purpose of reducing manufacturing cost involves one or more of the following possibilities:

Is the part necessary?

Can it be combined with another part?

Can a standard part be used?

The first question is necessary because of the tendency of some designers to carry design perfection far past strictly functional requirements. This fact and its effect on cost and manufacture is probably best illustrated by comparison of "before" and "after" designs of a mechanism, such as that shown in Fig. 6, now used to forcibly eject auxiliary fuel tanks that are to be dropped from an airplane.

Combination of parts is also an important means of facilitating manufacture. Further examination of Fig. 6 reveals that the design revision has combined the lower body and the attaching plate into one simple part.

Designers must always remember that while some ingenuity is required to adapt existing standards to a design, the part or assembly that it represents has to be produced many times during a contract. Failure in design to utilize a low cost standard in order to avoid manufacture of a costly special part results in expenditure many times greater than would have been required for extra time in original design.

The validity of the foregoing statements is illustrated by Fig. 7, which shows the before and after design of the retainer bolt used to hold the flap track bearings in place on an airplane. The clearances required a thin head of sufficiently large diameter to retain a bearing having ½ in. I.D. The revised design utilized a standard flap head machine bolt and a stamped washer to perform the same function with identical dimensional clearances.

Soundness of simplified designs also pays dividends from the service angle. Field engineers are quick to point out the fact that complicated mechanisms require frequent overhaul. The simpler the design, the fewer parts there are to maintain. Parts designed in such a way as to require special tools are particularly undesirable.

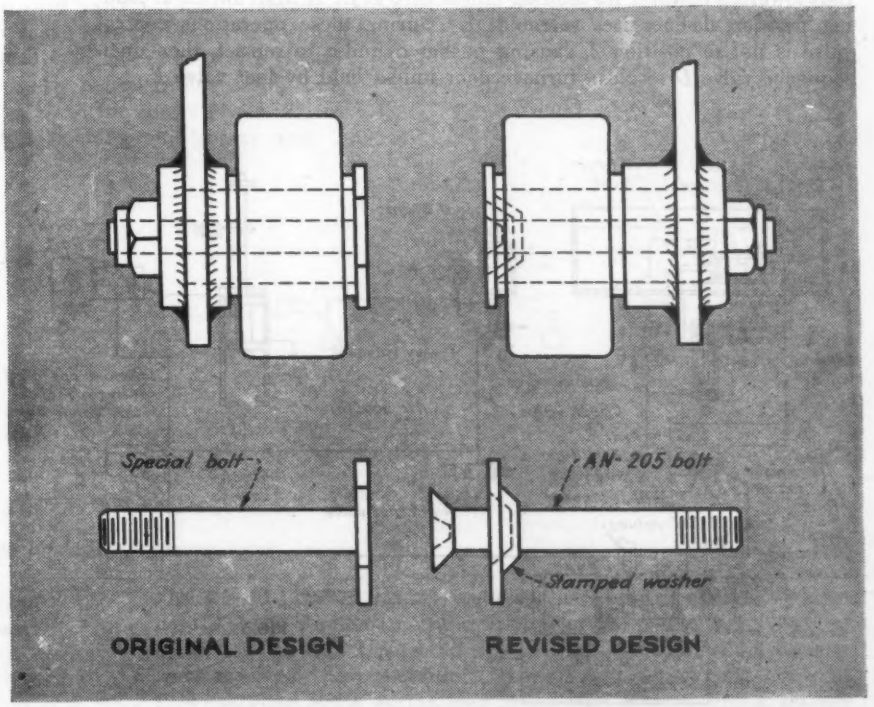


Fig. 7—Use of low-cost standard parts adds little extra time and cost to design as compared to production costs for special parts.

HYDRAULIC CIRCUITS AND

JAMES A. LEONARD, *Hydraulic Machinery Inc.*

Hydraulic operation of machines, sequencing of processing operations, and pressure testing have been developed to meet a wide range of conditions, often with interlocked timing of several operations. Automatic operation is often produced by electric solenoids activated by switches whose contacts are opened and closed by moving machine elements. Such operation is possible hydraulically also as shown in Fig. 4. These hydraulic operations, together with those presented last month indicate the possibilities of hydraulics for complicated operations.

FIG.1

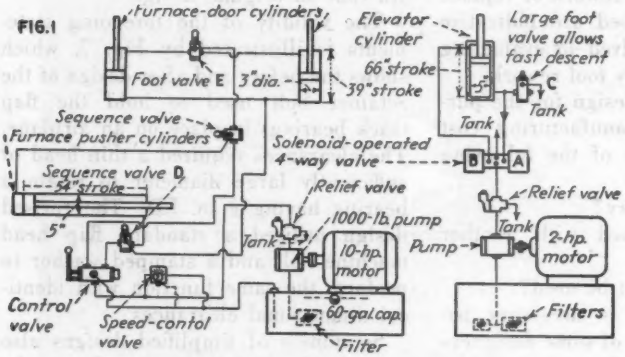


Fig. 1—Furnace doors are opened when control valve is at position 1. Pressure build-up then opens sequence valve to pusher cylinder, which pushes new tray into furnace and heated tray onto elevator where it contacts a limit switch that energizes solenoid *A*. This causes elevator to lower tray into quench tank and contact a limit switch that de-energizes solenoid *A* and starts a timer, which eventually energizes solenoid *B*. Tray moving off elevator contacts a limit switch that energizes solenoid *A* thus lowering elevator for loading unless held at *C*. A limit switch at loading position de-energizes solenoid *A*. During these operations control valve is put in position 2, causing pusher cylinder to retract, then open sequence valve *D* to close furnace door unless held by foot valve *E*.

FIG.2

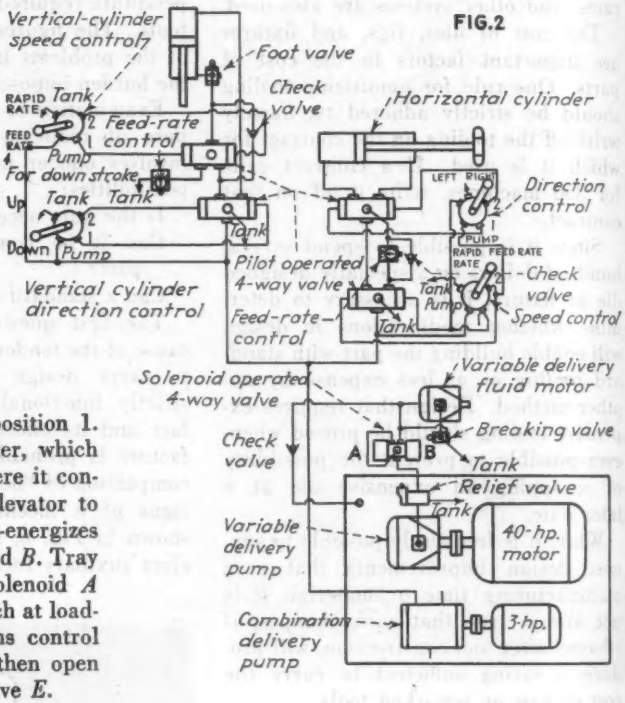


Fig. 2—Fluid motor on boring mill runs when solenoid *A* is energized and solenoid *B* is de-energized, and stops when the reverse is true. Push-buttons on panel control speed. Horizontal and vertical cylinder direction and speed are controlled by four 2-position pilot valves. Feed rate is regulated by a control valve.

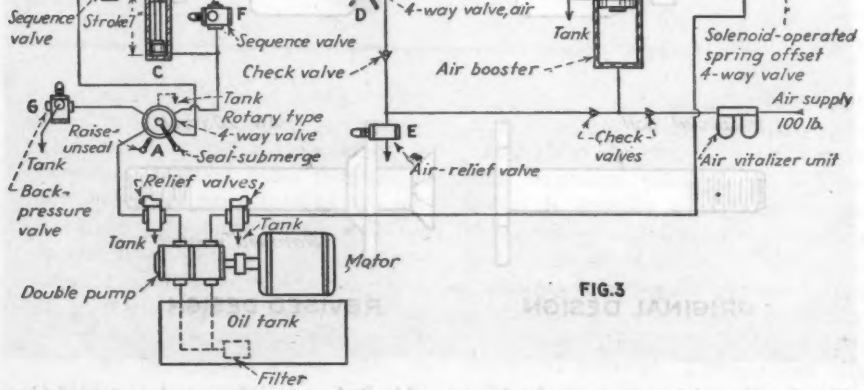


FIG.3

Fig. 3—End of part to be pressure tested is held in seal chamber by seal fixture when rotary valve *A* is in position shown. Pressure build-up opens sequence valve *B*, causing cylinder *C* to submerge test set-up. Air is admitted by moving valve lever *D* to position shown. Energizing solenoid *A* builds pressure in booster cylinder from 100 to 250 lb. Air pressure is released by reversing lever *D* and test set-up is raised by reversing valve *A*. Pressure build-up opens sequence valve *F*, thus releasing seal fixture.

THEIR OPERATION—II

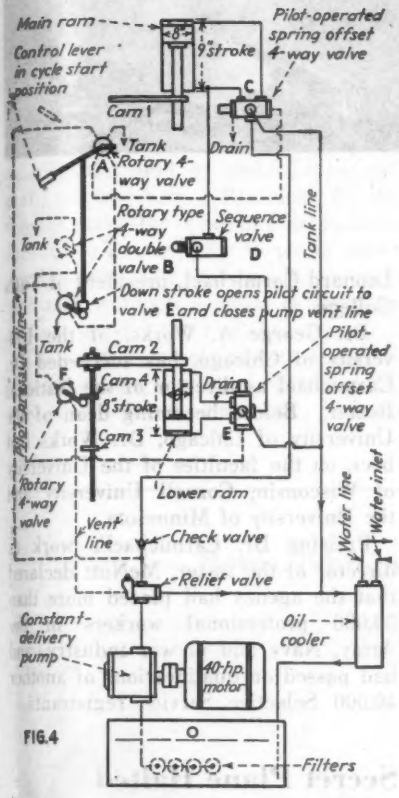
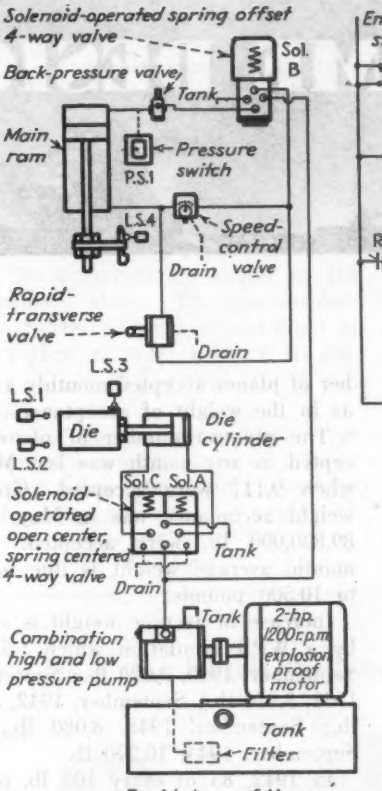


FIG. 4



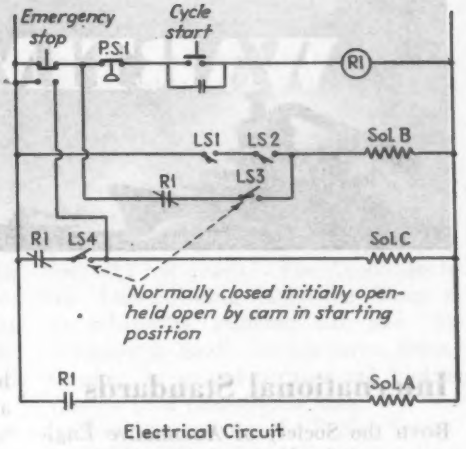


FIG. 5

Fig. 4—Main ram of press is started downward by moving lever of valve *A* to position shown, causing pilot pressure to shift valve *C*. Cam 1 reverses valve *A*, thus retracting ram and opening sequence valve *D* to valve *E*, which causes lower ram to eject work from die until cam 2 reverses valve *B* and cam 3 reverses valve *F*. Valve *F*, reversed slightly before *B*, keeps vent line closed. Valve *B* removes pressure from valve *E*, which allows lower ram to retract until valve *F* is reversed by cam 4, thus opening vent line to tank.

Fig. 5—Start button energizes solenoid *A*, causing die piston to close and contact switches P.S. 1 and 2. This energizes solenoid *B* through L.S. 3, which closed when cam moved with die, and causes main ram of press to move down on work until oil pressure opens P.S. 1, de-energizing solenoid *A* and energizing solenoid *C*. This causes die to retract, opening L.S. 3 and thus de-energizing solenoid *B*, which causes main ram to rise. Opening of L.S. 4 by ram de-energizes solenoid *C*, venting pump to the oil storage tank.

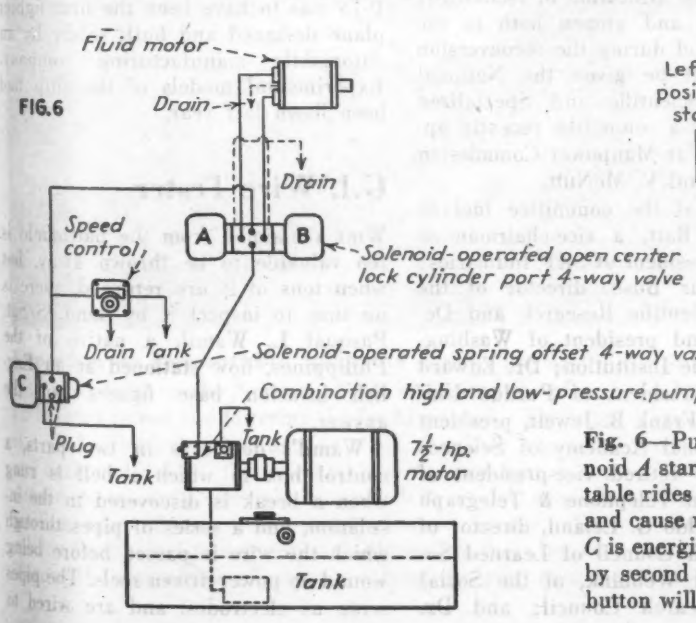


FIG. 6

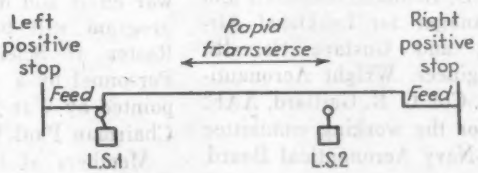


Fig. 6—Pushbutton energizing solenoid *B* and de-energizing solenoid *A* starts fluid motor, and mill table moves to left. When cam on table rides off L.S. 2, solenoid *C* is de-energized to close oil by-pass and cause rapid traverse to left. When L.S. 2 is contacted, solenoid *C* is energized again during feed to left stop. Return stroke, started by second pushbutton, goes through same cycle in reverse. Stop button will de-energize any solenoid and stop table in any position.

WARTIME DESIGN NEWS

International Standards

BOTH the Society of Automotive Engineers and the National Aircraft Standards Committee are represented by the group of technicians visiting the British Isles to study the British aircraft standards program in an attempt to bring about uniformity between English and American standards. The six-man delegation is repaying a visit to the U. S. aviation industry last spring by a British technical mission.

Ultimate objective is to achieve an international uniformity of industrial aircraft standards for parts, practices and materials. The mission is to spend four or five weeks in the United Kingdom, visiting typical aircraft centers and maintenance bases for several days each. Members of the mission include T. P. Hearne, chairman of the NASC's international standards project and Ryan Aircraft Standards engineer; Eric Dudley, assistant to the director of engineering, airplane division, Curtiss-Wright Corp.; E. W. Norris, director of technical services for the Aeronautical Chamber of Commerce; J. D. Redding, S.A.E., aeronautical representative; L. D. Bonham, materials and processes manager for Lockheed Aircraft Corp.; and Gustave Carvelli, standards engineer, Wright Aeronautical Corp. Lt.-Col. G. R. Gaillard, AAF, is observer for the working committee of the Army-Navy Aeronautical Board.

Bigger and Better Aircraft

AVERAGE WEIGHT of U. S. warplanes has more than tripled in the last four years, rising from an average airframe weight of 3,020 lb. a few months after the fall of France to the September average of 10,270 lb., the War Production Board revealed recently.

WPB labels the development of bigger and more powerful planes as the outstanding characteristic of the plane production program, which in recent months has seen a decline in the number of planes accepted monthly as well as in the weight of acceptances.

The greatest number of planes accepted in any month was last March, when 9,117 were accepted. Greatest weight acceptance was in May, when 89,800,000 lb. were accepted. This month, average weight is due to rise to 10,500 pounds.

Increase in average weight is shown by a WPB tabulation which follows: September, 1940, 3,020 lb.; September, 1941, 3,970 lb.; September, 1942, 5,960 lb.; September, 1943, 8,080 lb., and September, 1944, 10,270 lb.

In 1942, 85 of every 100 lb. of accepted aircraft was in tactical types, 15 percent in non-tactical trainers, communications and special-purpose planes. In October, 98 of every 100 lb. was in tactical types. Emphasis on the superbombers, which are about twice the weight of a Liberator or Fortress, is increasingly important in the trend.

Scientists in Reconversion

ADVICE on the utilization of technically trained men and women both in the war effort and during the reconversion program will be given the National Roster of Scientific and Specialized Personnel by a committee recently appointed by War Manpower Commission Chairman Paul V. McNutt.

Members of the committee include William L. Batt, a vice-chairman of WPB and president of SKF Industries; Dr. Vannevar Bush, director of the Office of Scientific Research and Development and president of Washington's Carnegie Institution; Dr. Edward C. Elliott, president of Purdue University; Dr. Frank B. Jewett, president of the National Academy of Sciences and recently retired vice-president of the American Telephone & Telegraph Co.; Dr. Waldo G. Leland, director of the American Council of Learned Societies; Paul Webbink, of the Social Science Research Council; and Dr. Leonard Carmichael, president of Tufts College.

Dr. George A. Works, of the University of Chicago, has succeeded Dr. Carmichael as director of the National Roster. Before becoming dean of the University of Chicago, Dr. Works had been on the faculties of the University of Wisconsin, Cornell University and the University of Minnesota.

Praising Dr. Carmichael's work as director of the roster, McNutt declared that the agency had placed more than 50,000 professional workers in the Army, Navy and in war industry, and had passed on qualifications of another 40,000 Selective Service registrants.

Secret Plane Halted

WORK on the P-75, a fighter airplane still on the secret list, has been halted at the Fisher Body Cleveland Aircraft Division, indicating further emphasis by the AAF on its program for concentration on a limited number of planes. Experimental work on the new plane will be continued by the AAF. The P-75 was to have been the first fighter plane designed and built solely by an automobile manufacturing company. Experimental models of the ship had been flown last year.

G.I. Wire Tester

WIRE reclaimed from the battlefield is too valuable to be thrown away, but when tons of it are returned, there is no time to inspect it by hand. S/Sgt. Pasqual L. Wamil, a native of the Philippines, now stationed at an English invasion base figures out the answer.

Wamil's device is in two parts, a control box in which a bell is rung when a break is discovered in the insulation, and a series of pipes through which the wire is passed before being wound on power-driven reels. The pipes serve as electrodes, and are wired to

the control box. Whenever a break in the insulation is found, a spark is relayed between the electrodes, ringing the control box bell. Then the break is located and repaired by hand.

Aircraft Turbine

VISIONS of a 10,000-hp. gas turbine aircraft engine are behind the disclosure that the Wright Aeronautical Corp. is entering the field of turbine-type aircraft power plants. President G. W. Vaughn says the company is looking forward to a new phase in power plant development, and that turbine propulsion may work on aviation as great an advance as did the radial motor.

The move does not indicate a sudden change in the course of Wright's engine development program, Vaughn made it clear, but is rather a logical and long-considered step. While developing radial engines, Wright engineers have been working in the related fields of jet propulsion and the gas turbine. The reciprocating, radial, air-cooled engine, Vaughn believes, will undoubtedly continue for years to be the foremost power source for all categories of air transport except the high-, speed, high-altitude and long-range class. Thus there will be no switch from the reciprocating engine to the gas turbine alone. The gas turbine, however, fits the trend toward flight at ever higher altitudes because its efficiency is greatest at high speed and altitude.

Wright's gas turbine ideas now encompass a power plant to drive a propeller rather than a turbine to drive an air compressor in a jet engine.

Weapons Developments

THE GERMAN RADIO TALKS of an electric machine gun in use on the Russian front and known to troops as the "death scythe." The British have disclosed that their new flamethrowers, the Crocodile, Wasp and Lifebuoy, can fire around corners. The reference apparently is to a jelly-like fuel which, splashing on the target, penetrates crannies into which the old-type liquid fuel did not reach. The Crocodile is the flamethrowing tank, the Wasp a flamethrowing armored car and the Lifebuoy a small, soldier-borne flamethrower, so named because the fuel is carried in a ring-shaped tank.

More impressive is the British "earthquake" bomb, a six-ton item described as the "most destructive air weapon ever used." With a delayed action

Retractable Ailerons Improve Black Widow Performance

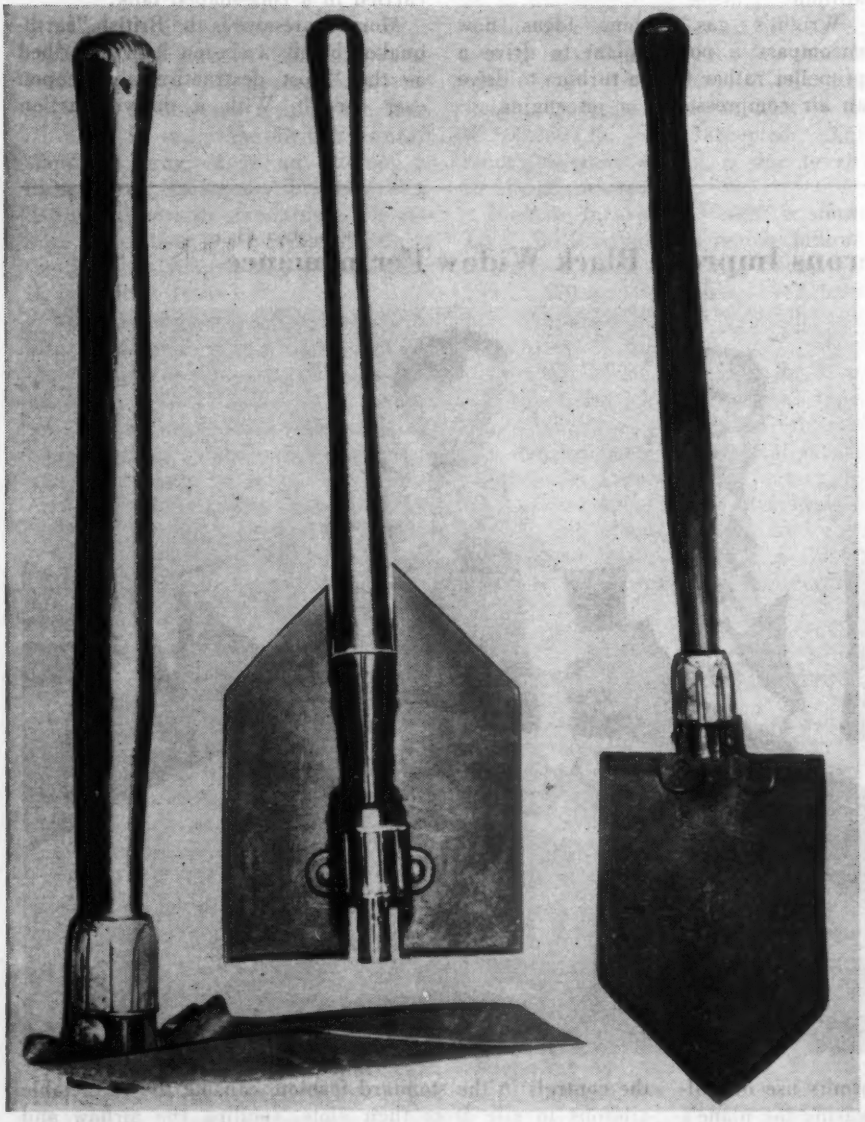
Adoption of retractable ailerons permits use of full-span wing flaps on the Northrop P-61, increasing the plane's air braking power and lowering the landing speed. The latter is a vital consideration in getting a big, fast ship into small and darkened fields. The retractable device is a long, scoop-shaped metal strip, entirely concealed in a slot near the trailing edge of each outer wing when not in use. Each aileron is attached to conventional ailerons on the wing tips. To use the retractable aileron for a turn, the pilot operates the controls in the standard fashion, causing the retractable ailerons to rise from their slots, spoiling the airflow and eliminating the lift of the wing. Despite its size, the P-61 can turn "on a dime" without danger of stalling immediately. The device grew out of the need for as much of a trailing edge of the wings as could possibly be devoted to regular wing flaps. Conventional ailerons use an appreciable portion of the trailing edge, cutting down the space available for wing flaps which cut down the landing speed.

fuse, it combines penetrating effect with its blast. Probably designed to get at such targets as the Nazi submarine pens, which were roofed over with tremendous thicknesses of reinforced concrete, the bomb could be used also for wave effect which the British are reported to have been using against small craft at anchor. This is achieved by dropping a huge explosive charge near anchored craft and setting up a tremendous wave to crush or otherwise damage the vessels. These waves also were to reach back into sub pens, it is reported.

Soapstone Goes to War

KAOLIN TALC, a derivative of soapstone, is being used for an insulating material which the Army Signal Corps finds better than any other ceramic material in some applications. Sometimes known as steatite, soapstone yields a talc which can be baked into the most intricate shapes. A tube of steatite as thin as a shingle nail sheathes even smaller wires. The material can be bent, is not affected by acids, intense heat or flame.

Entrenching Tool Improved Over German Design



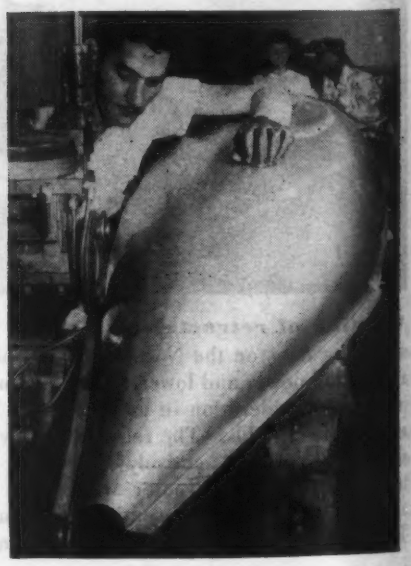
Redesign of a captured German entrenching tool is responsible for this new U. S. Army field shovel which can be used as a shovel, a mattock or carried with the blade folded back. The tool was modified and improved from the German version by the Quartermaster Corps. The blade is locked in position by a knurled nut. German design utilized a high-alloy steel blade and a plastic positioning nut. American design has the blade formed from alloy steel. The improved die cast positioning nut weighs only a few ounces more than Nazi model, costs less.

Mirror Finish Boosts Speed

GRUMMAN'S new F6F-5 Hellcat fighter is reported to be 20 knots faster than its predecessor, and one of the reasons for the increase is the mirror-smooth finish which has been substituted for the paint previously used. Rough finish was used to cut down sun reflection flashes, a provision which was found not particularly necessary. The waxed paint substituted for the rough finish paint is believed to add about six knots to the plane's speed. Other refinements include better fairing of the engine cowling, strengthening of the tail and stabilizer, new ailerons lending increased maneuverability at high speeds, increased armor plate behind the pilot and the removal of two braces from the windshield.

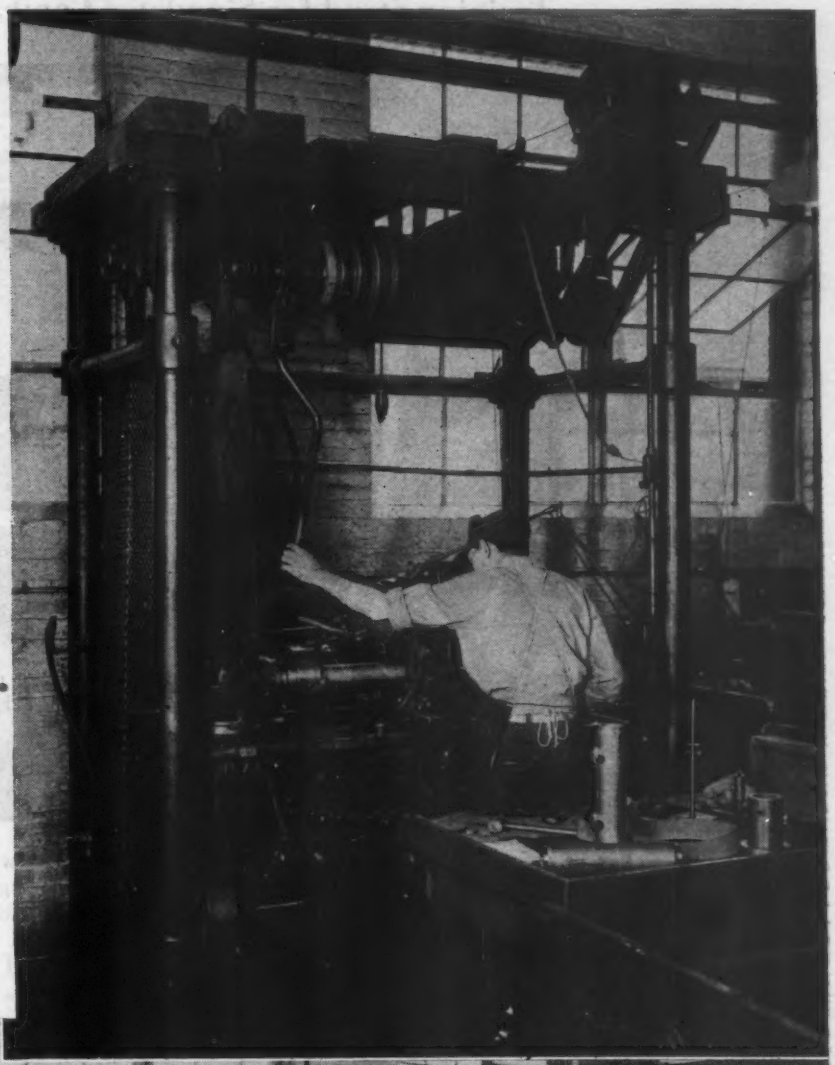
Droppable Tanks Are Spot and Seam Welded

AFTER ALL the component parts have been installed in the tank, the two halves are spot welded together on this automatic machine at the plant of the Weber Showcase & Fixture Company. Fourteen to sixteen overlapping spots per inch are placed at the rate of 5 ft. per min., the overlapping spots forming a continuous welded seam.

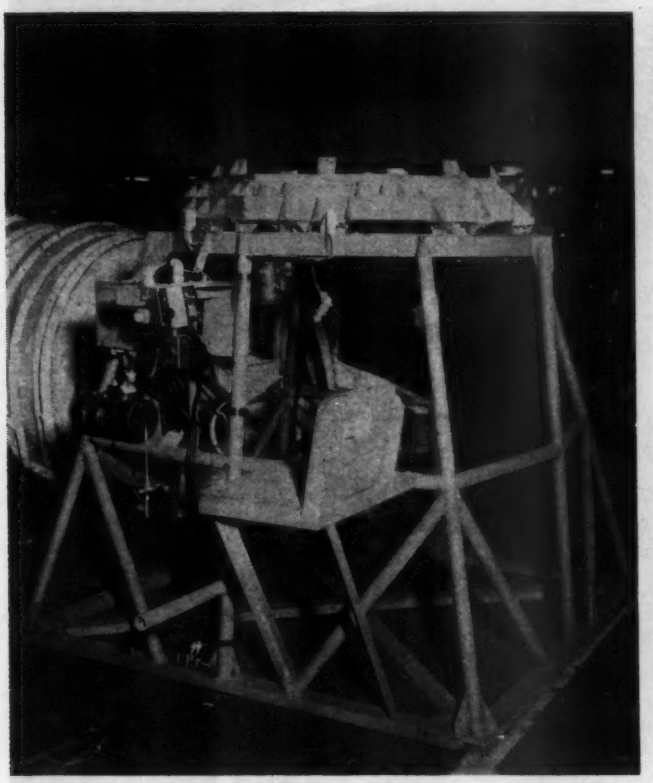


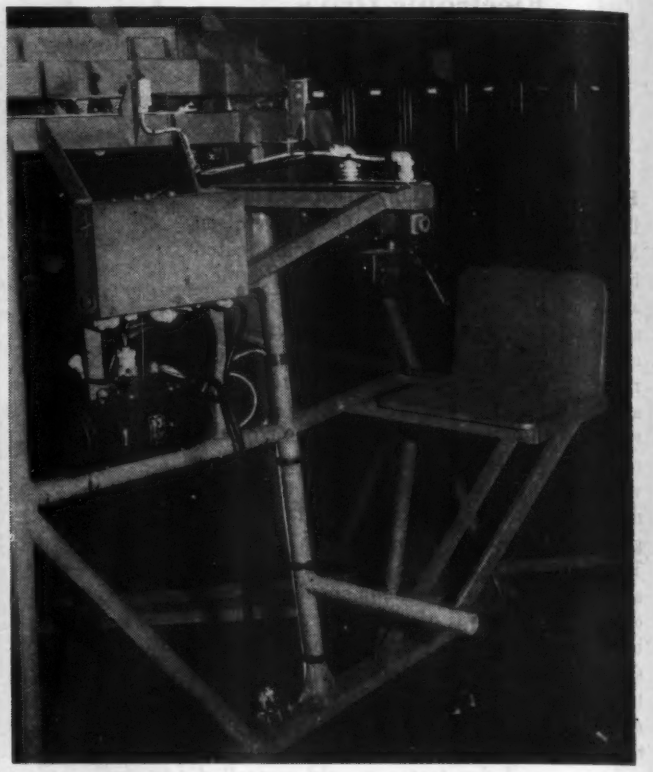
Electronic Drive Rejuvenates Old Machines

Problems in machining hardened pump liners on 30-year-old machines at Avelson Manufacturing Company were complicated by specifications requiring finished tolerances of 0.001 in. The variation in liner sizes and materials required grinding speeds over a wide, closely regulated stepless range in order to secure desired tolerance and finish. To improve quality, reduce vibration and gain stepless speed control, the company replaced belt and pulley drives with Westinghouse "Mot-O-Trol" electronic drives. In addition physical advantages were gained in the new layout of the machine. The three grinders were reset on a 35-deg. angle with a saving in floor space of about one-third. Removal of all overhead pulleys, belts and shafting resulted in increased safety, improved illumination and elimination of vibration. Appreciable savings in set-up time were also effected. The electronic drive consists of four essential units; a shunt-wound d.c. motor, a grid-controlled thyratron rectifier together with the necessary auxiliary control tubes, a separately mounted transformer and a pushbutton control station with speed-control rheostats.



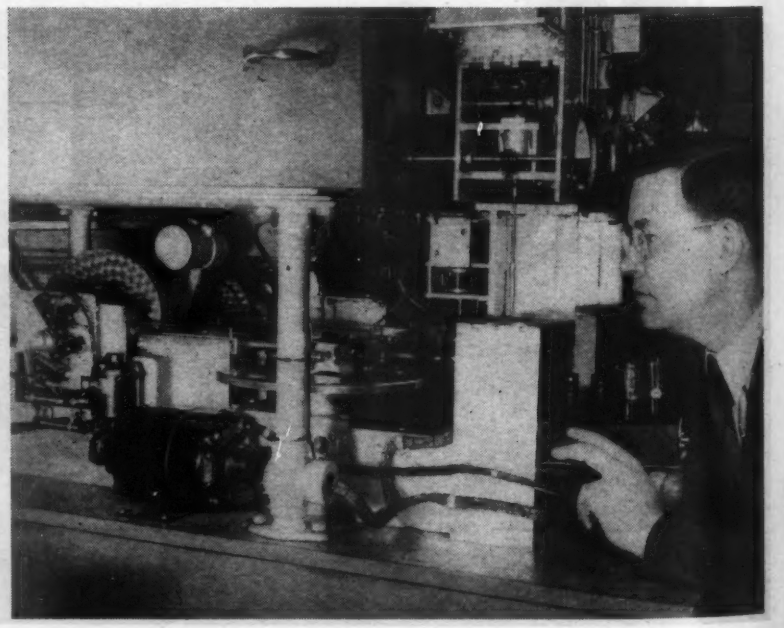
Training Stand for Simulated Combat Conditions





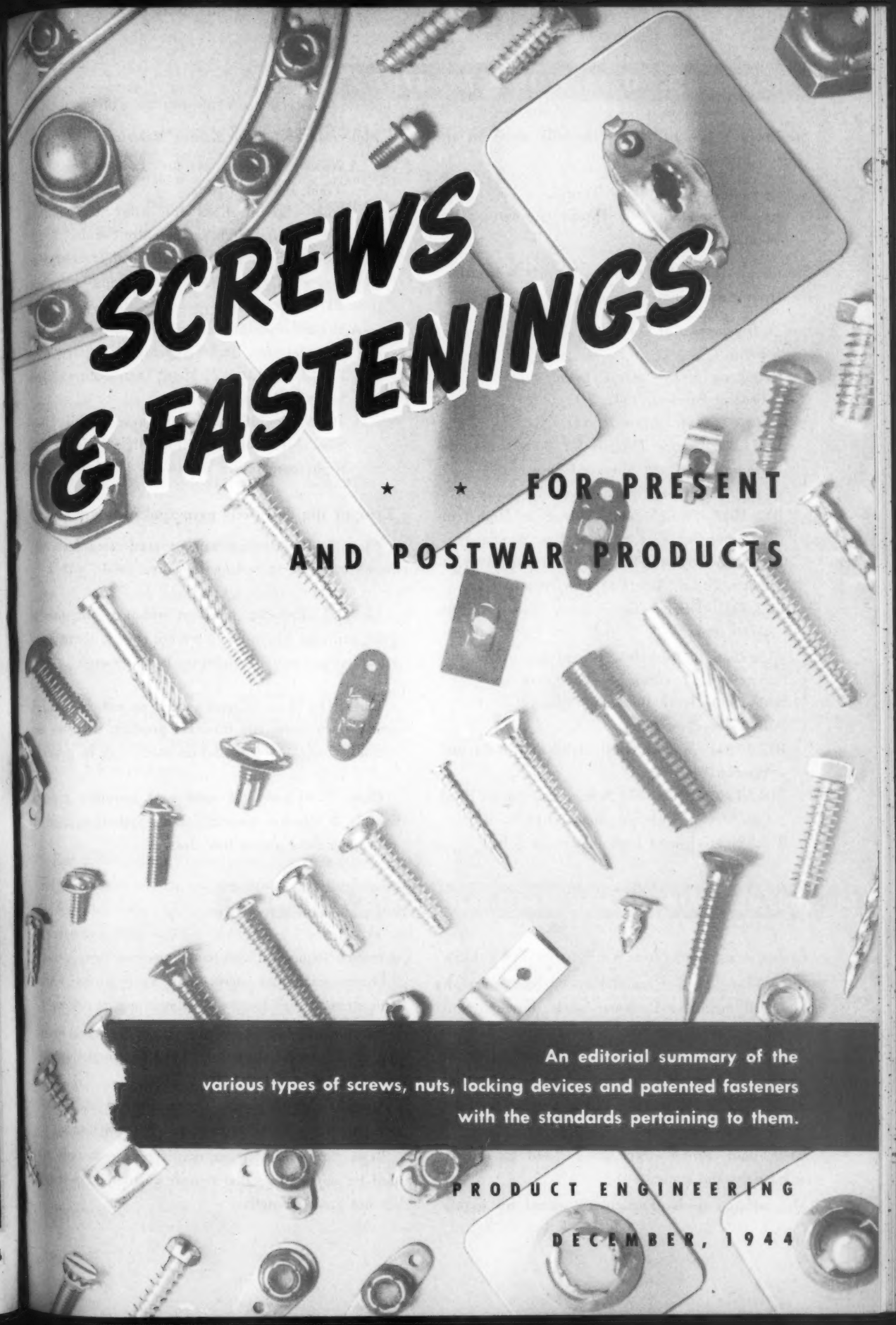
Originally developed at the request of Army Engineers, this new stand was designed and approved, the first unit manufactured in the Glenn L. Martin Experimental Department and shipped to the Army within six weeks of the time the original inquiry was received. Mounting a standard power-driven turret, the stand provides a seat and controls for an instructor whereby he is able to control the movement both of a target airplane swinging on a wire and the "bomber" on which the turret is supposedly mounted. The instructor can provide every combination of attacking maneuvers and evasive action. The stand is constructed of welded tubes and simple rolled shapes.

Mechanical "Brain" Tests Turbine Nozzles



Developed by General Electric for testing turbine nozzles for maximum efficiency, this machine utilizes compressed air instead of steam. The air is blown at various pressures through a nozzle sample and the machine measures, records and adds up energies at various points on the nozzle.

A disk, similar to a phonograph-turntable, rotates. Pressure variation moves tiny upright wheels back and forth. The rotation of these wheels is conveyed by rotating shafts of light through a special light-polarizing sheet of glass to photoelectric tubes. The tubes control a series of cams and gears in a servo-mechanism which operates a printer. The printer in turn adds up energies and indicates over-all energy loss.



SCREWS & FASTENINGS

★ ★ FOR PRESENT AND POSTWAR PRODUCTS

An editorial summary of the various types of screws, nuts, locking devices and patented fasteners with the standards pertaining to them.

PRODUCT ENGINEERING

DECEMBER, 1944

STANDARD BOLTS, NUTS AND STUDS

Standard types of screw threads used in the United States are —

American Standard Coarse Thread
American Standard Fine Thread (formerly S.A.E. Standard)

Standards for bolts, nuts and studs recognized by American industry are —

U. S. Department of Commerce, National Bureau of Standards

Handbook H-28—Screw-Thread Standards for Federal Services, 1942.

American Standards Association

B1.1-1935—Screw Threads for Bolts, Nuts, Machine Screws and Threaded Parts.
B1.2-1941—Screw Thread Gages and Gaging.
B1.4-1942—Straight Screw Threads for High Temperature Bolting (American War Standard).
B1.6-1944—Screw Threads of Truncated Whitworth Form (American War Standard).
B5.1-1941—T-Slots—Their Bolts, Nuts, Tongues and Cutters.
B18c-1930—Slotted-Head Proportions of Machine Screws, Cap Screws and Wood Screws.
B18d-1930—Track Bolts and Nuts.
B18f-1928—Plow Bolts.
B18.2-1941—Wrench-Head Bolts and Nuts and Wrench Openings.
B18.3-1936—Socket Set Screws and Socket-Head Cap Screws, with Supplement B18.3a-1944.
B18.5-1939—Round Unslotted Head Bolts.

American Society for Testing Materials

A 76-33—Specifications for Low-Carbon Steel Track Bolts and Nuts.
A 96-39—Specifications for Alloy-Steel Bolting Material for High-Temperature Service.
A 183-40—Specifications for Heat-Treated Carbon- and Alloy-Steel Track Bolts and Nuts (Tentative).
A 193-40—Specifications for Alloy-Steel Bolting Materials for High-Temperature Service from 750 to 1,100 Deg. F. Metal Temperatures (Tentative).
A 194-40—Specifications for Carbon- and Alloy-Steel Nuts for Bolts for High-Pressure and High-Temperature Service to 1,100 Deg. F.

Type of fits and their principal uses are —

Class I—Loose-fitting nut or stud used only for rough work, as in bolting structural steel.

Class II—Free fit, used on ordinary commercial bolts and nuts where loads are not severe, there is no vibration and extreme tightness is not essential.

Class III—Close fit representing an extremely high grade of commercially threaded product, used on automobile bolts and nuts and on machinery in general.

Class IV—Closest fit used and requires ground threads or selective assembly. Bolts and studs used in aircraft engines are in this class.

METALS COMMONLY USED FOR BOLTS AND NUTS

Carbon steels ranging from S.A.E. 1010 to S.A.E. 1065.

Free-cutting steels—Generally low-carbon steel high in sulphur, including Bessemer steels. Strength and uniformity of these materials is generally not as high as that of the low-sulphur open-hearth carbon steels.

Manganese steels—S.A.E.-T 1335. This material, containing 1.60-1.90 Mn is stronger and tougher than the conventional carbon steels.

Nickel and chrome-nickel steels—Used for highly stressed bolts and studs.

Molybdenum steels—Particularly suited for highly stressed bolts used in high-temperature service.

Chrome-vanadium steels—For applications where high strength and fatigue resistance are required.

Chrome-nickel steels—Containing 8-20 percent nickel and 17-26 percent chromium. Used for corrosion and heat-resistant applications.

Straight chrome steels—Containing up to 18 percent chromium. For corrosion and heat resistance.

Brass, bronze and other non-ferrous materials are used for applications that require corrosion resistance but not great strength.

DESIGNS OF BOLTS AND STUDS

Shapes and proportions of various types of standard bolts, nuts and cap screws can be found in handbooks and manufacturers' literature.

DESIGNS FOR MAXIMUM STRESS AND SHOCK LOADS. The threaded section, being the weakest, has a larger cross-sectional area, thereby permitting the body to be stressed to the maximum allowable. (See Fig. 1)

To permit better stress distribution among the gripping threads of a steel stud in aluminum, the stud is made hollow. (See Fig. 2) For an explanation and discussion of this, see "Design of Highly Stressed Studs to Improve Their Fatigue Life," beginning on page 288 of the May, 1943 number of PRODUCT ENGINEERING.

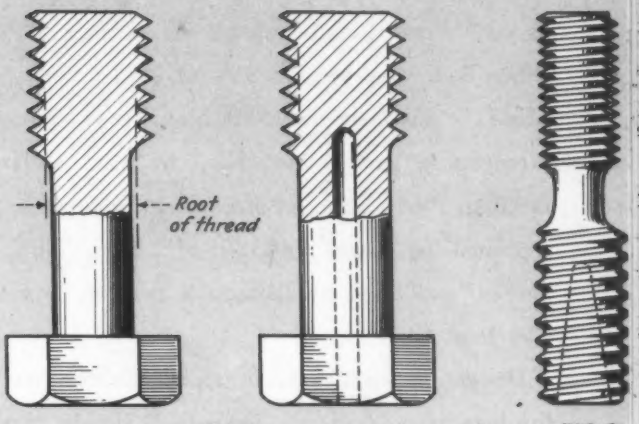


FIG.1 FIG.2

ADVANTAGES OF HOLLOW-HEAD SCREWS

Using standard hex-head bolt and nut, l_s must equal the hex diagonal plus wrench clearance.

Using hollow-head cap screws, l_h equals the diameter of the round head plus a slight clearance.

For equal loads, P, the bending moments on the flanges are $P\,l_s$ and $P\,l_h$ respectively, the appreciably smaller value of the latter permitting a thinner flange. (See Fig. 3) For further explanation see "Advantages of Using Hollow and Socket-Head Screws" beginning on page 130 of the April, 1935 number of PRODUCT ENGINEERING.

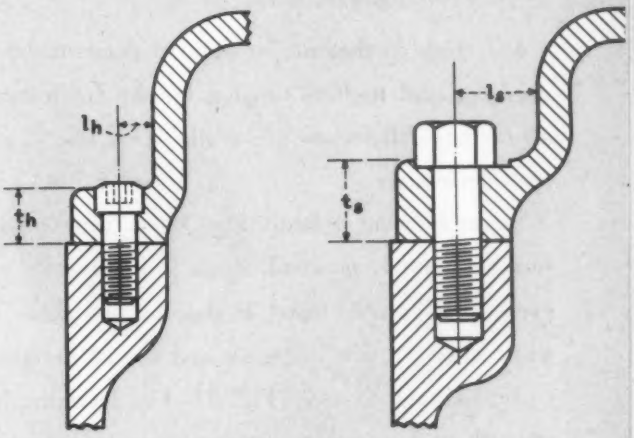


FIG.3

STRESSES IN SCREWS

For a discussion of torque-stress-load relationships in bolts and screws, see the Reference Book Sheets under that title published on pages 752-754 of the November, 1943 number of PRODUCT ENGINEERING and reprinted on pages 151-153 of "Bolts, Nuts and Screws," published by Lamson & Sessions Company, Cleveland, Ohio. Also, see "A Photoelastic Study of Bolt and Nut Fastenings" in the same book.

Failure of screws in many types of joints is caused by a combination of shear and bending stresses. (See Fig. 4) Recessed-head types that are formed in cold forging operations have their strength increased through controlled grain flow, also under applied load the stress concentration in the head is minimized by the shape of the recess.

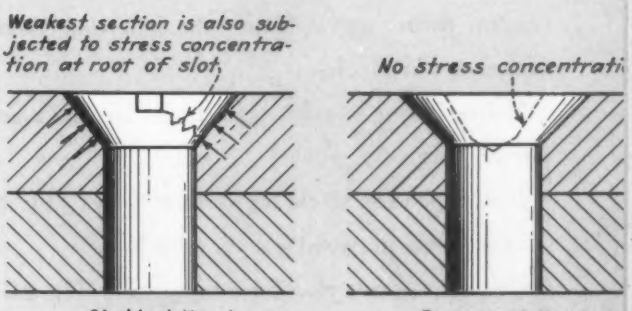

Weakest section is also subjected to stress concentration at root of slot
No stress concentrati
Slotted Head
Recessed Head

FIG.4

STUDS IN VARIOUS MATERIALS

Strength of studs driven into various materials such as steel, brass, aluminum, zinc die castings, phenolic sheets and compressed boards of hard or soft wood fibers is discussed in "Machine-Screws—Fastening Strengths in Various Materials," by A. C. Millard in the Oct., 1943 number of *Mechanical Engineering* and reprinted on pages 144-150 of "Bolts, Nuts and Screws" published by Lamson & Sessions Company, Cleveland, Ohio.

Design of steel studs in aluminum castings and forgings is covered in "Design of Highly Stressed Studs to Improve Their Fatigue Strength," on pages 288-290 of the May, 1943 number of PRODUCT ENGINEERING.

STUD-TYPE FASTENINGS

For studs in material or type of construction that does not lend itself to tapping for the application of screws, special devices are available. A few of many such devices are—

Rosan Locking System (Fig. 1)—A threaded-in insert for plastics, plywood, wood and metals or wherever a replaceable insert is desired. Available in a wide range of sizes, materials and special designs.

Aero-Thread System (Fig. 2)—For fastening high-strength studs or cap screws in aluminum, magnesium or other soft material. Metal insert with standard thread on outside and special thread inside is screwed in tapped hole. Stud with corresponding special thread is screwed into the insert.

For brittle materials that cannot be threaded, such as cement, plaster and concrete, the following fastening devices are available—

Malleable-iron expansion shield for lag and machine screws. (Fig. 3A)

Lead expansion shield for various screws. (Fig. 3B)

Lead shield for wood screws. (Fig. 3C)

Encased rawhide plug for woodscrews. (Fig. 3D)

Toggle-head bolt. (Fig. 3E)

Metal caulking plug for wood and lag screws and machine bolts. (Fig. 3F)

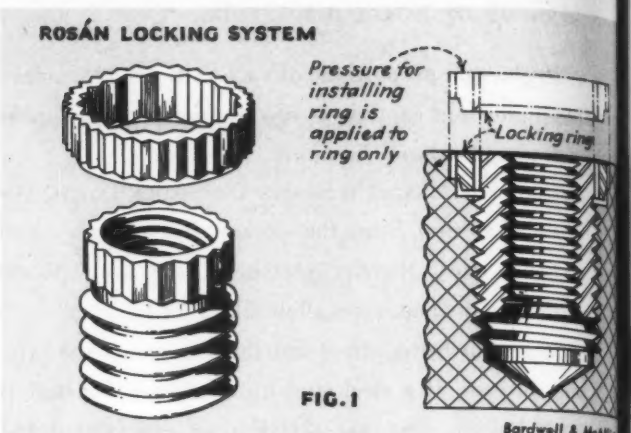


FIG. 1
Bardwell & McAl

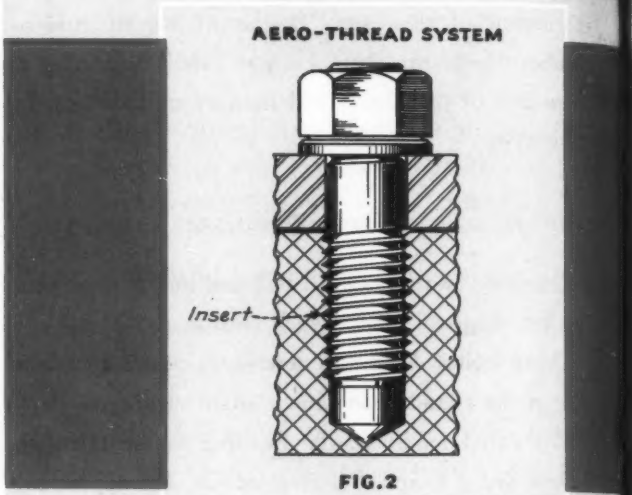
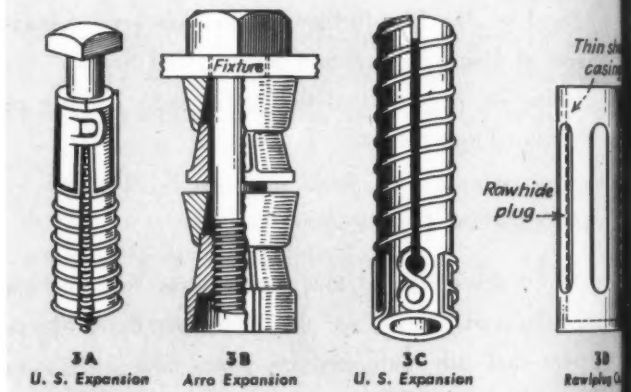
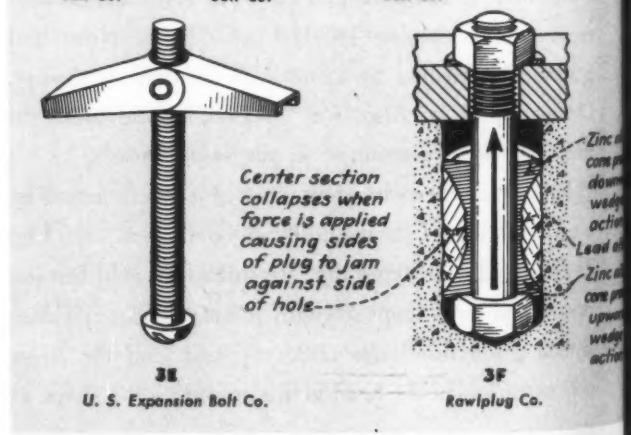


FIG. 2
Aircraft Screw Products Co.



3A U. S. Expansion Bolt Co.
3B Arro Expansion Bolt Co.
3C U. S. Expansion Bolt Co.
3D Rawlplug Co.

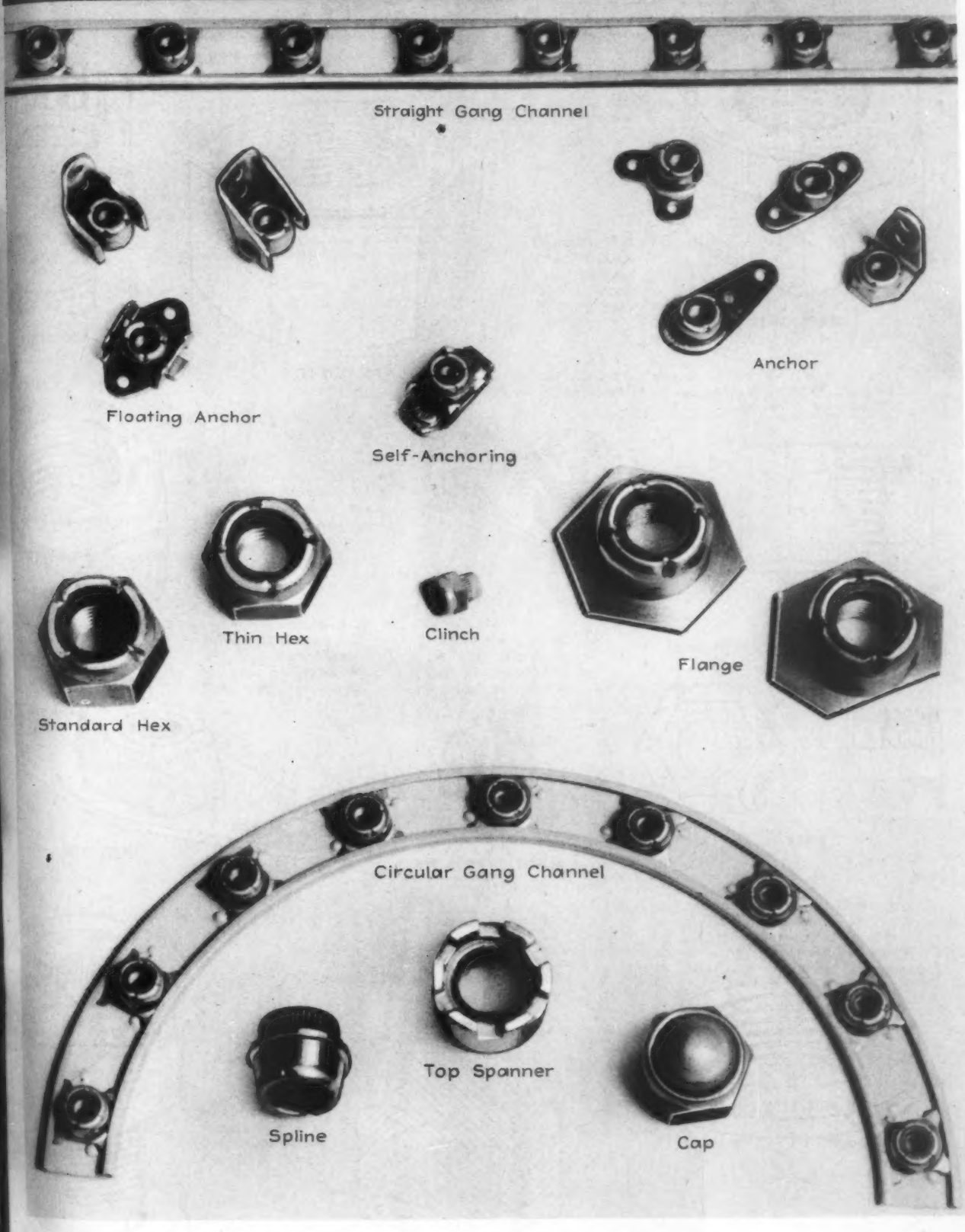


3E U. S. Expansion Bolt Co.
3F Rawlplug Co.

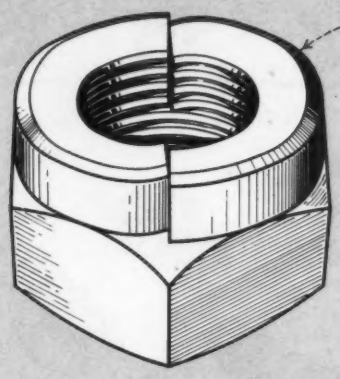
FORMS IN WHICH LOCK NUTS ARE AVAILABLE

Many of the lock nuts shown on the following pages are available in various forms to suit particular applications. Some of these forms are illustrated below.

Elastic Stop Nut Corp. of America

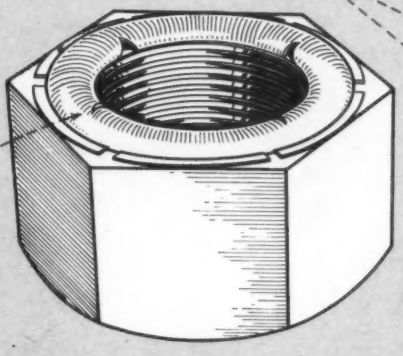


LOCK NUTS MADE IN U.S.A. AND CANADA



Upper part of nut is slotted and turned in to provide spring grip

AEROTIGHT



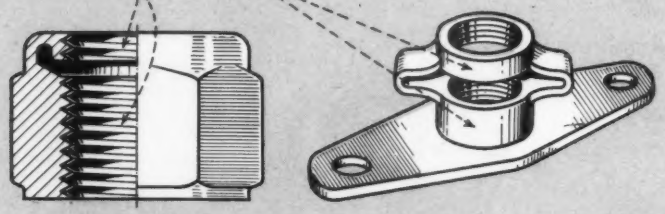
Fiber plugs pass through nut and press against threads of bolt

Soft metallic collar flattens against work, forcing edges into bolt thread

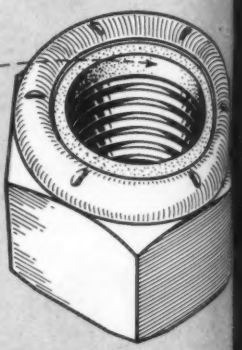
AN-COR-LOX

UNBRAKO

Threads of two sections are normally out of phase. Tightening sets up compressive force to provide holding



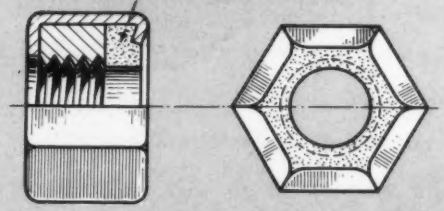
BOOTS



Fiber collar grips bolt threads. Also available with metallic collar in place of fiber for high-temperature applications

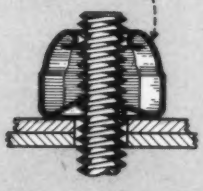
ESNA

Fiber collar grips bolt threads



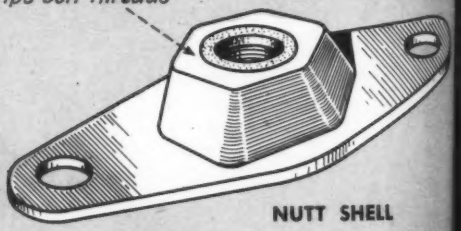
FIBRE

Top portion exerts spring pressure for added grip. No other nut is used with this type



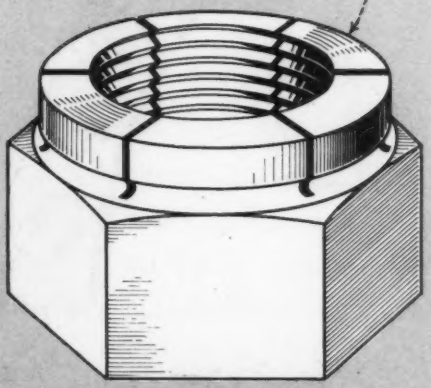
PALNUT TYPE 6 NAO

Conventional nut pressed into light metal shell with fiber collar, which grips bolt threads



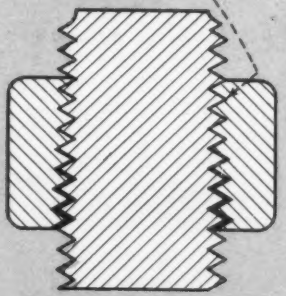
NUTT SHELL

Segments press against bolt threads because inner diameter of upper part is slightly less than outside diameter of bolt



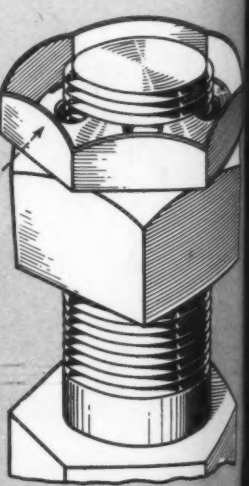
FLEXLOC

Upper part of conventional nut is deformed to elliptical shape that provides spring grip against bolt threads



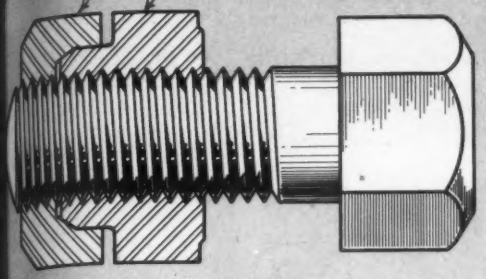
STOVER

Single-thread lock nut applied and tightened after regular nut is in place



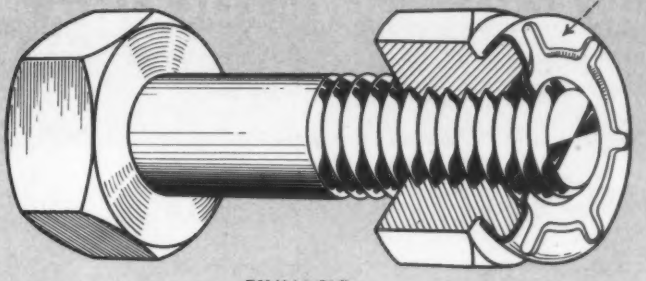
PALNUT

Consists of two separate mating parts



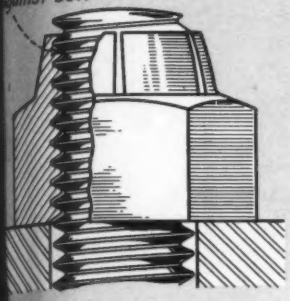
DRAKE

Metal diaphragm provides spring locking action



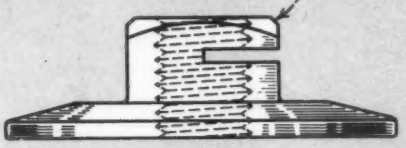
PINNACLE

Upper threads press inward against bolt



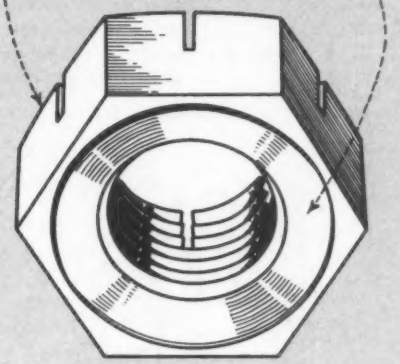
HUGLOCK

Threads in section above slot are deformed to provide friction grip



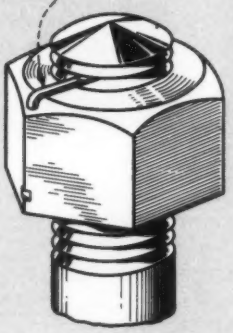
SEALTITE

Segments are forced inward against bolt threads when pressure is applied against recessed bearing surface

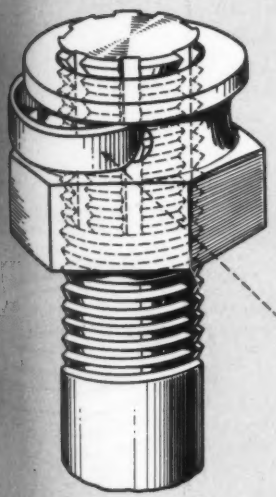


MARSDEN

Pin impinges against bolt to hold nut in place



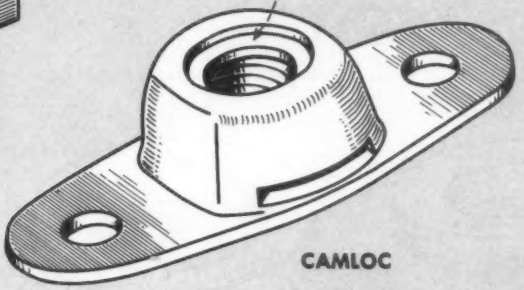
ANCO



Snap ring engages serrations in bolt thread to hold nut in place

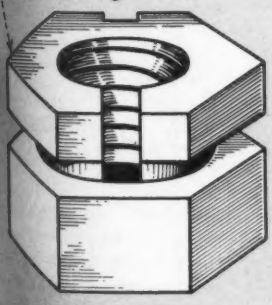
SIMLOK

Fiber collar grips bolt thread



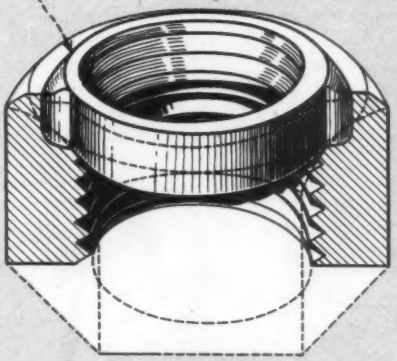
CAMLOC

Upper part of two-section assembly wedges into lower part when tightened



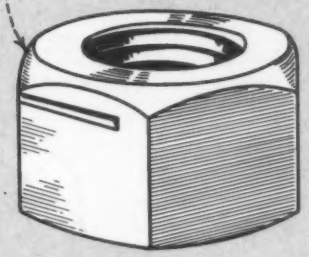
COLUMBIA

Elliptical alloy-steel retainer grips bolt threads



SECURITY

Threads in section above slot are deformed to provide friction grip

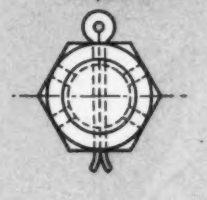


SELF-RETAINING

LOCK WASHERS AND LOCKING METHODS

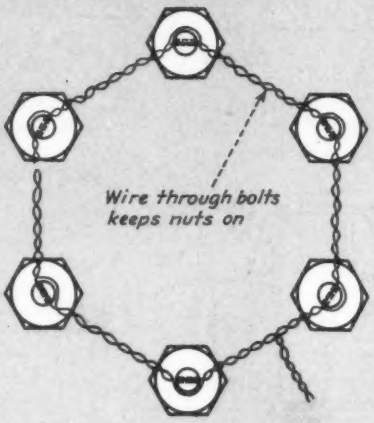
Representative examples of standard and special lock washers and locking methods. For list of manufacturers, consult Spring Washer Institute.

CASTELLATED NUT AND COTTER PIN.



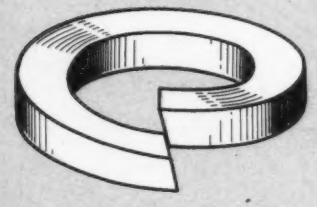
COOKE-MICRO SLOTTED NUT. This is a special design of castellated nut, the slots being arranged so that there are 14 to 22 locking positions.

Automatic Screw Machine Products Co.

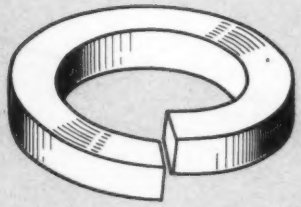


WIRED-LOCK—The bolts are drilled, the same as when castellated nuts are used, to permit a wire to be run through them.

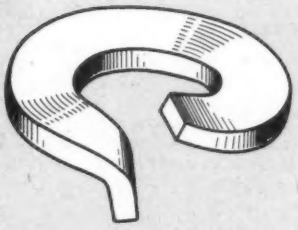
TYPES OF LOC



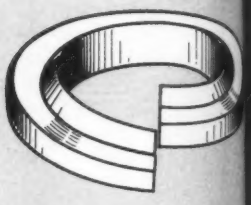
KANTLINK—A non-entangling spring lock washer used on all types of machinery and suitable for applications similar to Knolink type. Its angle-cut ends tend to embed more deeply and engage the nut face and bolted surface.



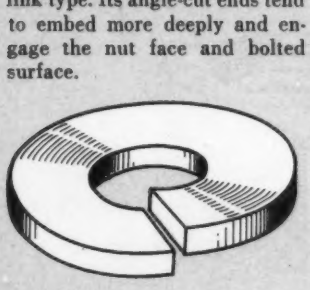
KNOLINK—A non-entangling spring lock washer suitable for general use and application on all types of automotive, farm implement, electrical, stove or industrial equipment, made in sizes to S.A.E. and Government AN-935 specifications similar to Kantlink type.



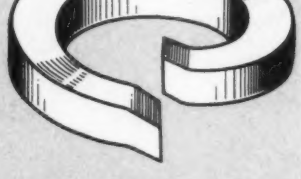
WOOD SPRING—Made in wide, thin surface sections. For use with nut, screw or bolt on soft surface material such as wood, rubber, plastics, fiber compositions or soft thin sheet metal. The anchor end embeds in the surface and turned-up end engages the nut, screw or bolt face.



RIBBED TYPE "C"—The rib o
the inner periphery under co
pression wedges itself into t
bolt thread and nut chan
while introducing reactive pr
sure and tension in its assem

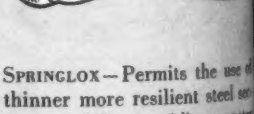


WIDE BEARING—For use in place of flat washers but with the added feature of automatic compensation for wear or developed looseness in the assembly. Particularly suitable for use on wood or materials subject to shrinkage, also for wide clearance holes. Its tempered surface acts as a thrust bearing.



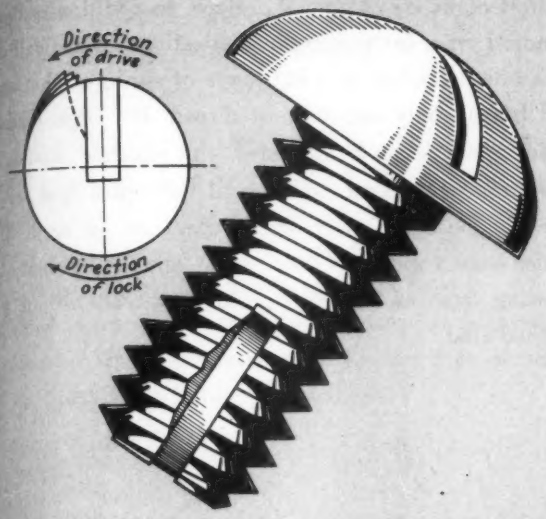
POSITIVE TYPE "D"—The barbs on the ends of this spring lock washer, under compression, embed themselves in the face of the nut, screw or bolt, and bolted surface, providing resistance to back turning.

NONLINK POSITIVE—A non-entangling spring lock washer combining the features of Kantlink and Positive types for use when these special features are needed.

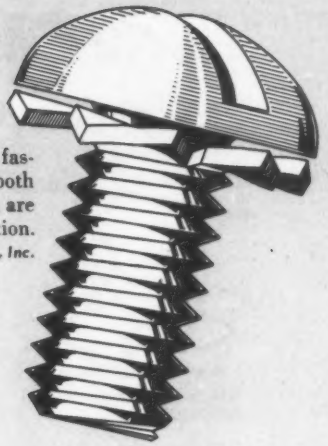


SPRINGLOX—Permits the use of thinner more resilient steel sections, while providing greater reactive tension than available from identical size steel sections in the helical spring washer design. Also, does not dig in or serrate bolted surface; particularly suitable for aeronautical applications.

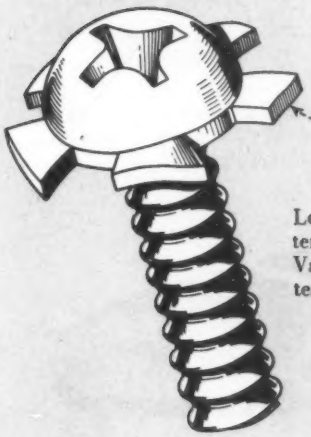
Reliance Spring



SHANK-LOCKING SCREWS have a slot cut in the lower part of the threaded section and spread apart so that there is a "bulge" which acts as a spring to produce a friction contact against the threads of the tapped hole.
Shakeproof, Inc.

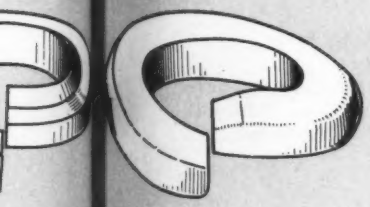


PREASSEMBLED threaded fasteners and washers with both internal and external teeth are available to speed production.
Shakeproof, Inc.

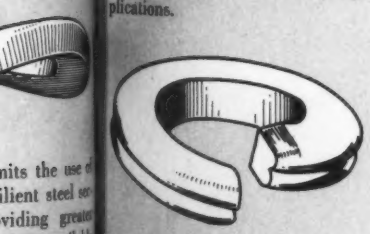


LOCKING FLANGE in Holtite fasteners is integral part of head. Various head types and fastener sizes are available.
Continental Screw Co.

PES OF LOCK WASHERS

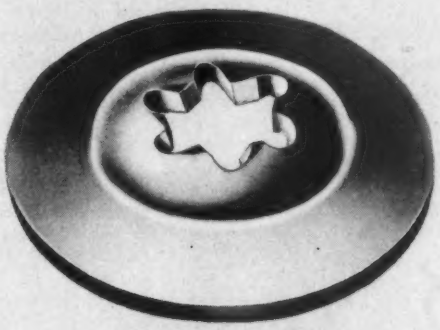


ROUND EDGE HY-CROME—Specially processed high-quality alloy-steel spring washer made to specification requirements for each bolt size. Rounded edges avoid heat cracks. Particularly suitable for use on high-quality product and for heavy-duty applications.

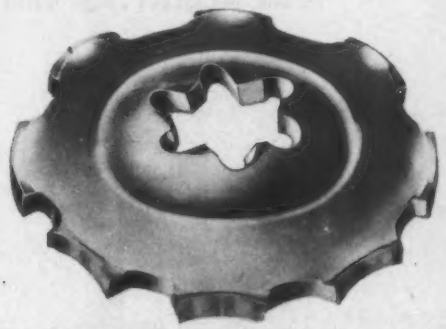


HY-PRESSURE HY-CROME—Possesses superior strength and provides reactive pressures considerably in excess of A.R.E.A. specifications, has superior reactive values for each bolt size.

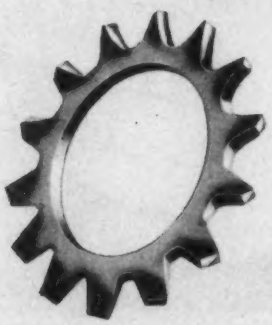
INTERNAL AND EXTERNAL TEETH—Teeth embed in face of work and bolt. External-tooth type is more generally used; internal-tooth type is used where smooth outer edge is desired and for other specific applications.



DOME INTERNAL



DOME EXTERNAL-INTERNAL



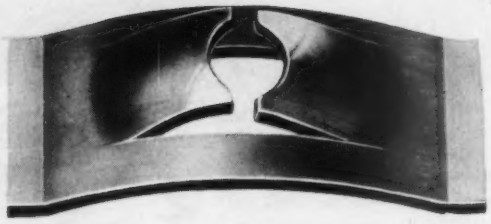
EXTERNAL

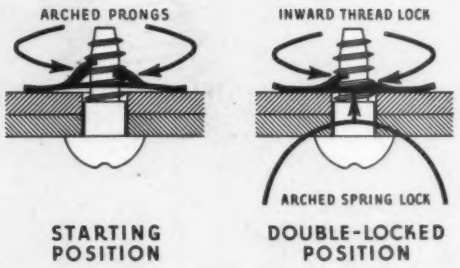
INTERNAL

EXTERNAL-INTERNAL

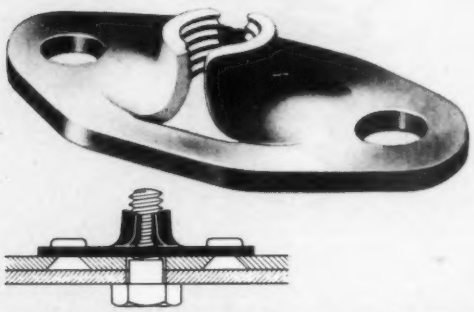
Manufacturing Co.

Shakeproof, Inc.

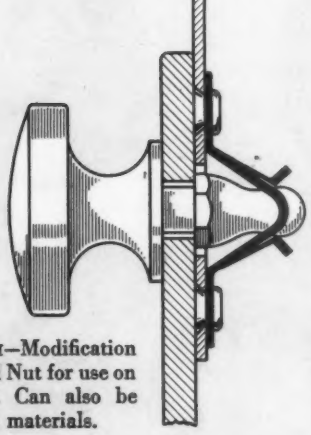




STANDARD FLAT-TYPE SPEED NUT—When tightened the prongs press against the stud and the strip acts as an arched spring lock.



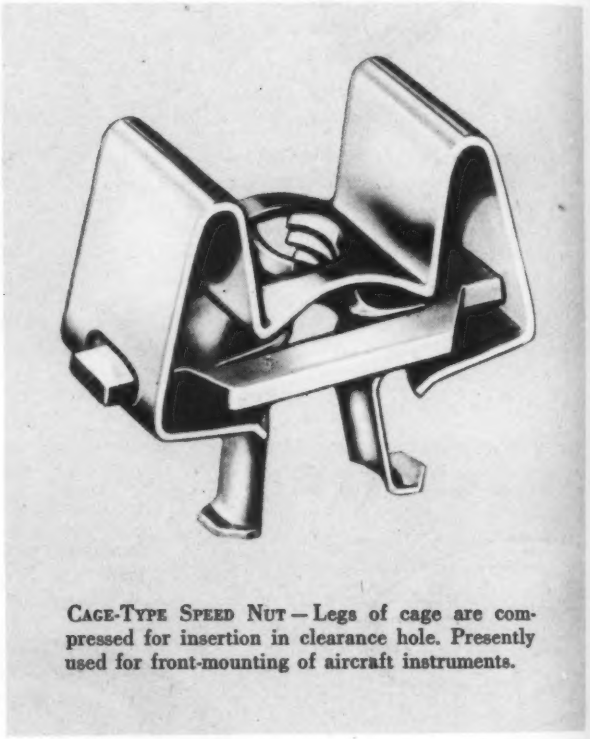
HI-STRESS SPEED NUT—Acts as a constant-torque fastener. Threaded prongs hold stud or bolt by friction and arched spring action.



SPEED NUT LATCH—Modification of standard Speed Nut for use on doors or covers. Can also be used with textile materials.

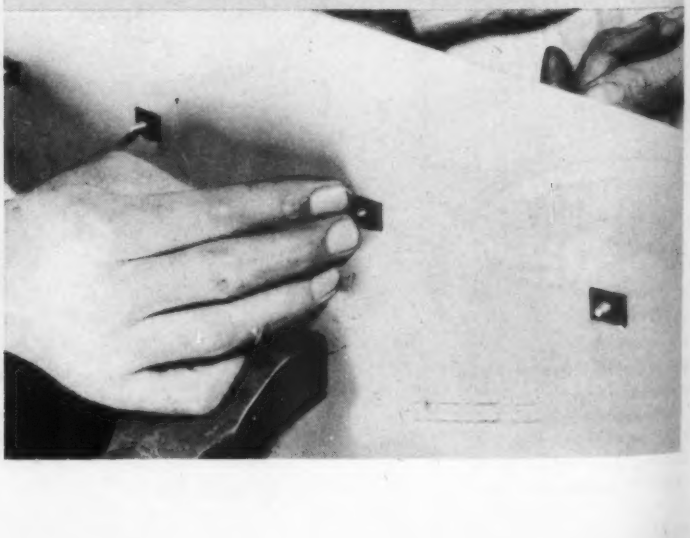
TINNERMAN SPEED NUTS

A versatile type of fastener obtainable in an almost unlimited variety of special designs, in addition to the standard type, for particular applications. Technically, it can be described as a nut made of spring-steel strip and having only one turn of thread. For high loads these fasteners can be obtained with multiple threads. They are self-locking and one of their principal features is the speed with which they can be applied. Under some conditions they can be applied by merely pressing them on the stud or screw threads or on a notched stud.



CAGE-TYPE SPEED NUT—Legs of cage are compressed for insertion in clearance hole. Presently used for front-mounting of aircraft instruments.

Ease of application of standard-type Speed Nuts is shown in this illustration.



SCREWS FOR UNTAPPED HOLES

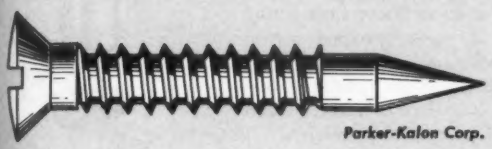
Several types of screws are available for use in holes that are not tapped. Typical of these are—

Self-Tapping Screws.
Drive Screws.

Self-tapping screws are used for fastening sheet metal, castings, plastics, plywood and similar materials. They have specially designed threads for different applications and are available in all standard head forms including Phillips recessed head.

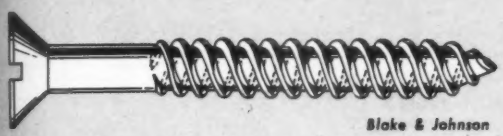
Drive screws are driven into untapped holes with a hammer. They are used for the same general field of applications as self-tapping screws.

SPECIAL TYPES OF SCREWS



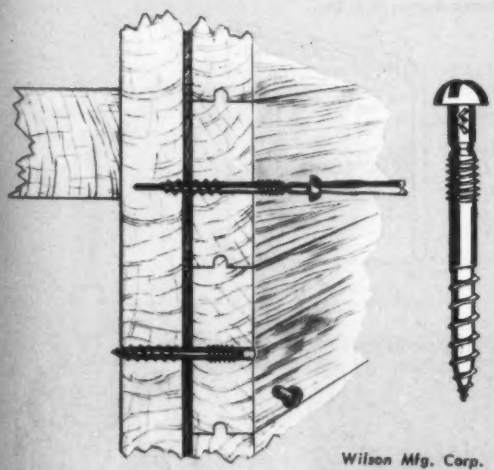
Parker-Kalon Corp.

SELF-PIERCING SCREW—For attaching wood panels to light structural parts without having to drill lead holes. Screw is hammered through wood and into metal, then turned down with screw driver.



Blake & Johnson

TWIN-THREAD SCREW—Has two parallel threads that start at opposite sides of cylindrical-contour shank and terminate in a single point. It is used for wood and plastic assemblies.



Wilson Mfg. Corp.

DOUBLE-THREAD SCREW—Two threads of different pitch pull layers of material together by an amount equal to the difference of the pitches. For use in wood. Head can be broken off after screw is driven.

TYPES OF SELF-TAPPING AND DRIVE SCREWS

SELF-TAPPING SCREWS

For fastening all types and thicknesses of metal

For plastics. Note double slot

For metals and plastics. Note multiple slots

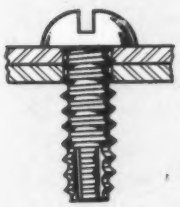
For plastics. Has coarse lead

Shakeproof

For metals. Forms, rather than cuts, threads

For sheet metal up to 18 gage, plywood, asbestos and composition materials.

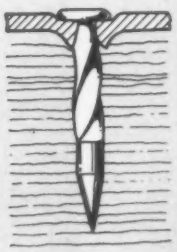
For sheet metal up to 6 gage, non-ferrous castings, plastics, plywood, asbestos and composition materials.



For heavy-gage sheet metal, castings, structural steel, plastics and plywood.

DRIVE SCREWS

For heavy-gage sheet metal, castings, forgings, structural steel, plastics and plywoods.



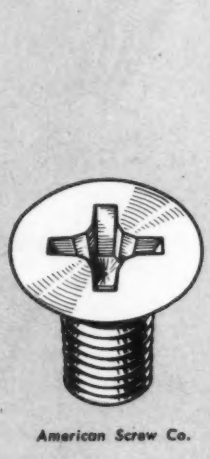
For fastening sheet metal to wood

For fastening such materials as fabric, fiber, leather and cardboard to light-gage sheet metal.

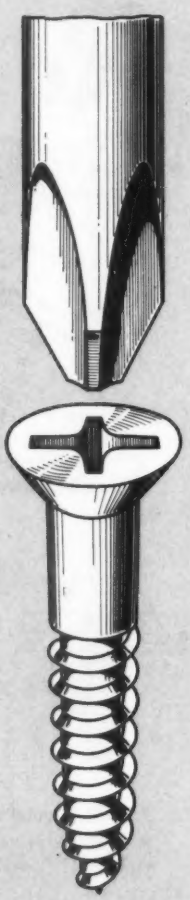
Parker-Kalon Corp.

RECESSED-HEAD SCREWS AND BOLTS

Various types of recessed heads can be provided in screws and bolts. Some of the outstanding examples are shown here.

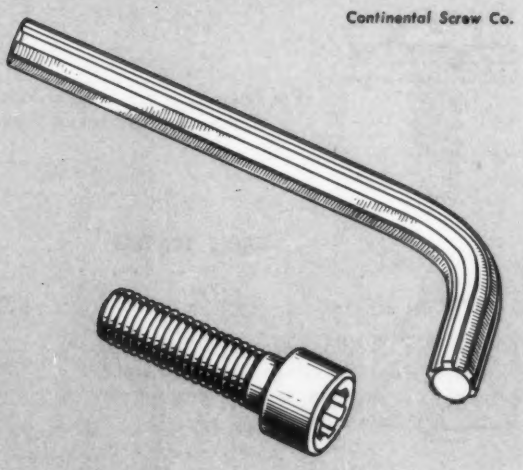


American Screw Co.



Continental Screw Co.

PHILLIPS HEADS are available with flat planes at the corners or with rounded corners. Special drivers are recommended for application, although an ordinary screw driver can be used.

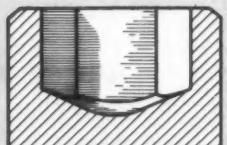


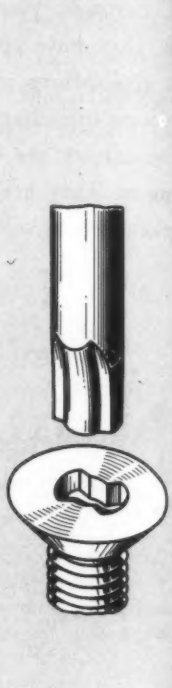
MULTIPLE-SPLINE HEADS have greater torque resistance during installation and greater service strength. A special wrench is needed for installation.

Bristol Co.

HEXAGON-SHAPED RECESSES are also widely used in space-saving applications, for example, where bolts or studs must be as close as possible to walls of structures. Special wrench is necessary.

Hala-Krome Screw Corp.





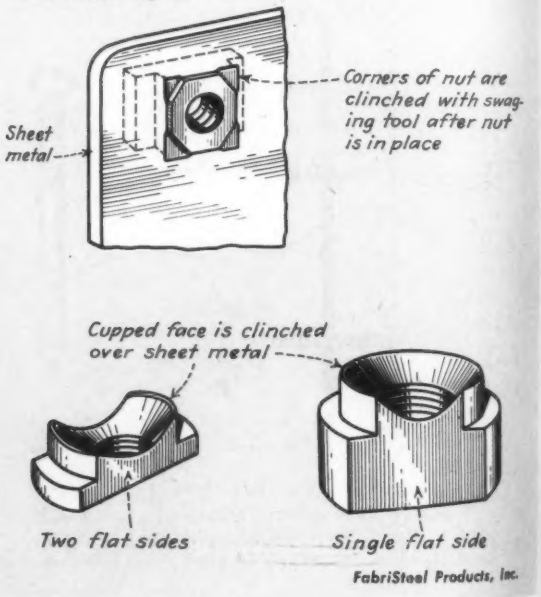
CLUTCH-HEAD SCREWS AND BOLTS have a special-shaped recess that takes either a special or an ordinary driver. Slight backward twist causes screw or bolt to lock on special driver.

United Screw & Bolt Corp.

CLINCH NUTS

Several types of nuts that are held in place by inserting in holes in sheet metal are available. The sheet keeps them from turning during assembly.

Thorrez & Maes Mfg. Co.


Corners of nut are clinched with swaging tool after nut is in place
Sheet metal
Cupped face is clinched over sheet metal
Two flat sides
Single flat side

FabriSteel Products, Inc.

RIVETS

Standard rivets can be obtained in a wide variety of materials, sizes and head shapes. Dimensions of these rivets and the materials from which they are manufactured are covered in the following standards recognized by American industry—

American Standards Association

B18a-1927—Small Rivets, with Addendum B18a1-1942.

B18g-1929—Tinners', Coopers' and Belt Rivets, with Addendum B18g1-1942.

B18.4-1937—Large Rivets.

American Society for Testing Materials

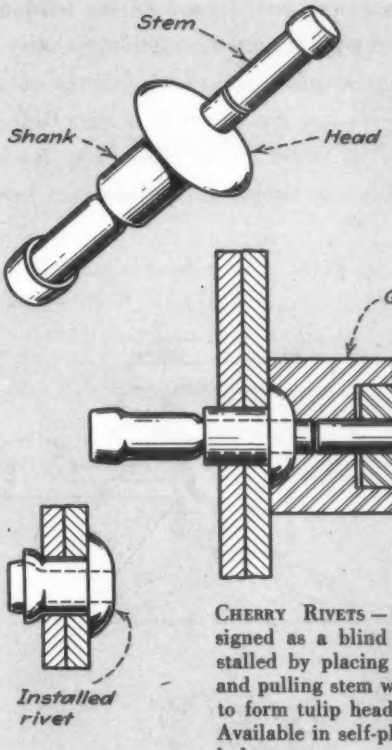
A 31-40—Specifications for Boiler Rivet Steel and Rivets.

A 141-39—Specifications for Structural Rivet Steel.

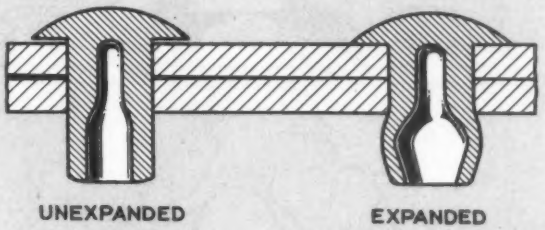
A 152-39—Specifications for Wrought Iron Rivets and Rivet Rounds.

A 195-41—Specifications for High-Strength Structural Rivet Steel.

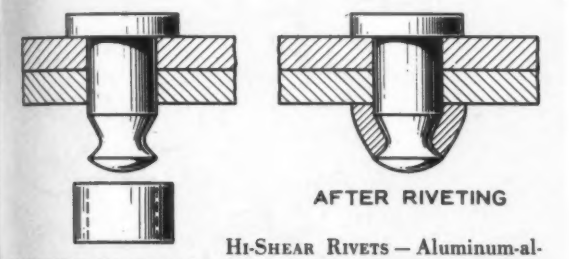
Various special rivets are available to meet specific conditions. Among these are the following—



CHERRY RIVETS—Originally designed as a blind rivet, it is installed by placing shank in hole and pulling stem with special tool to form tulip head on blind side. Available in self-plugging and tubular types. *Cherry Rivet Co.*

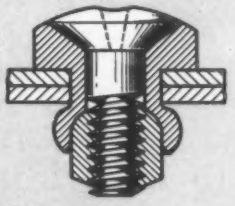


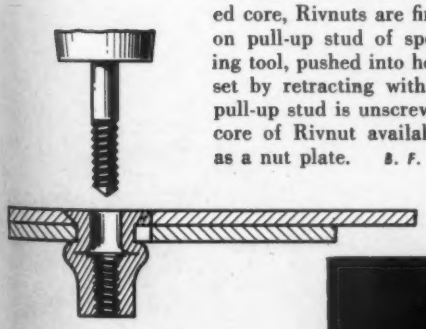
EXPLOSIVE RIVETS—Explosive in shank cavity is detonated with electric gun, expanding charged end of shank and forming a blind head.
E. I. duPont deNemours & Co.



HI-SHEAR RIVETS—Aluminum-alloy collar is placed over alloy-steel pin and squeezed on and trimmed with special tool.
Pheoll Mfg. Co.

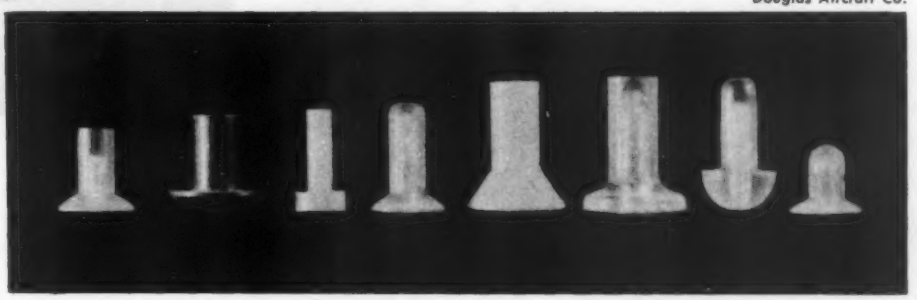
PRECO RIVET—Consists of steel screw inserted in hollow stem of high-strength aluminum-alloy rivet and a dural nut threaded on the end of the screw. Rivet is expanded with screw-driving tool. *Preco, Inc.*





RIVNUTS—Provided with a threaded core, Rivnuts are first screwed on pull-up stud of special heading tool, pushed into hole and upset by retracting with tool, then pull-up stud is unscrewed leaving core of Rivnut available for use as a nut plate. *B. F. Goodrich Co.*

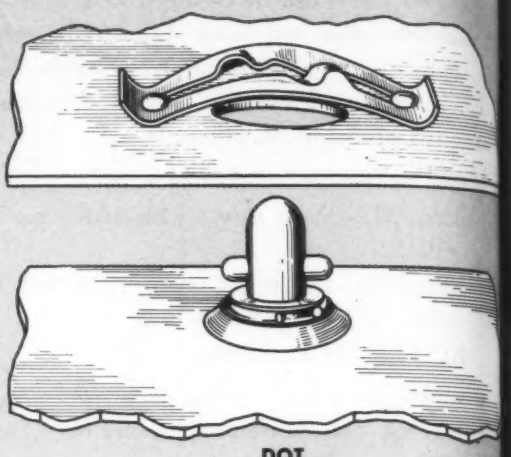
Douglas Aircraft Co.



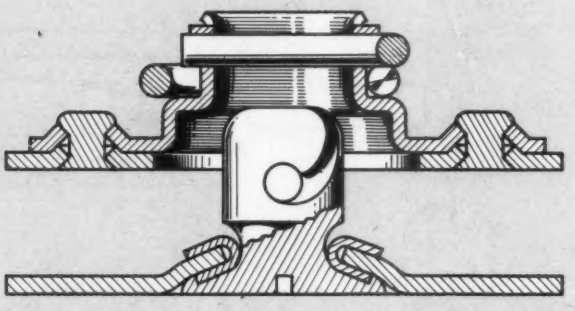
PLASTIC RIVET—Made of various thermoplastic materials, plastic rivets can be used for non-stress applications such as fastening fabric to metal, wood or plastic sheets. They are essentially blind rivets.

QUICK-DETACHABLE FASTENERS

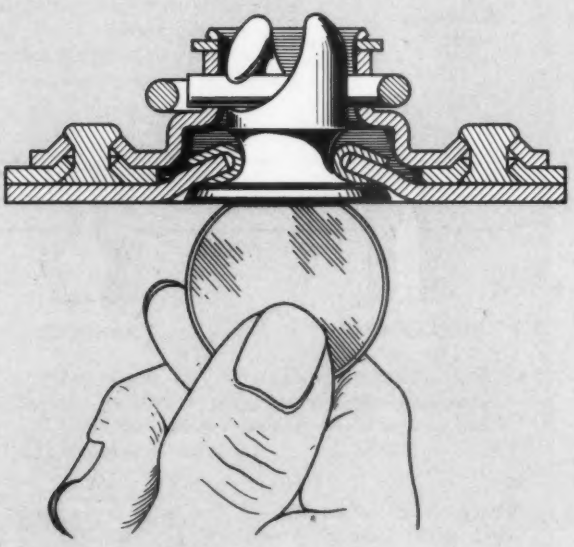
Spring-lock fasteners that depend on the tension of a slotted stud and a spring for their holding ability are widely used for doors and covers which must be quickly and easily opened when the necessity arises. Different sizes are obtainable. Some of the types of spring-lock fasteners available are shown in the sketches below.



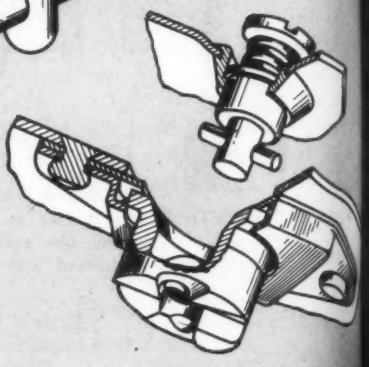
DOT

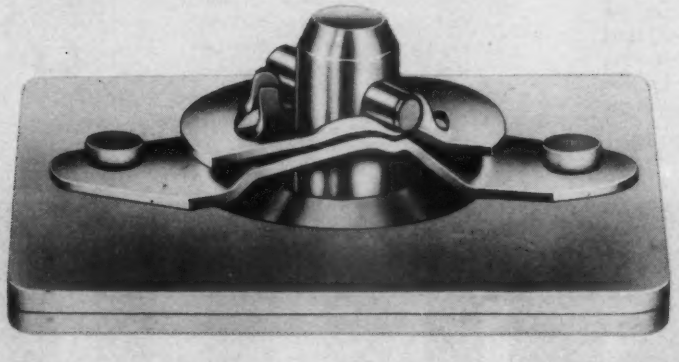


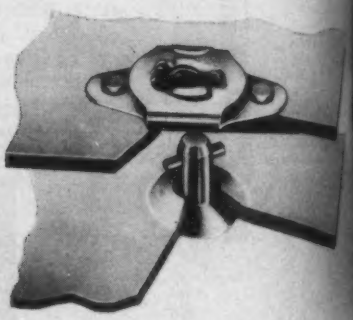
CAMLOC



ESNA

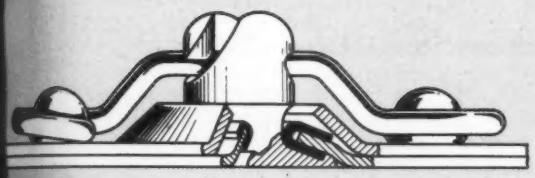




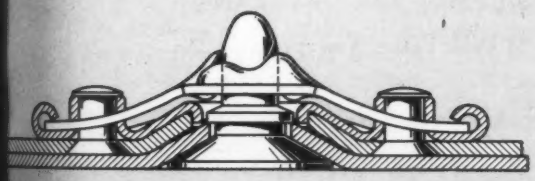


SHAKEPROOF

SIMLOK

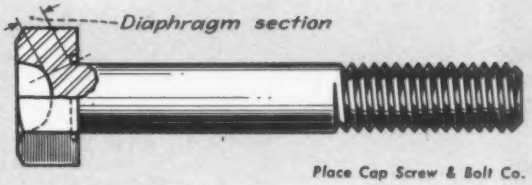


DZUS



LION

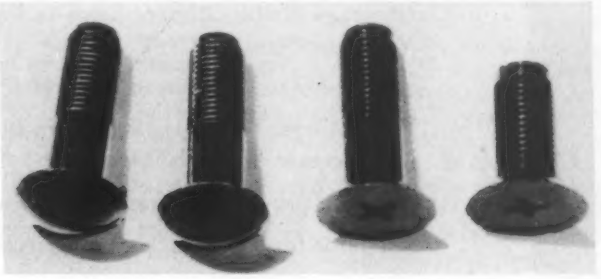
SELF-LOCKING BOLT



Place Cap Screw & Bolt Co.

Diaphragm-head design adds to elasticity of bolt. Can be used for applications similar to those of conventional bolts and cap screws. Locking is provided by spring action resulting from recesses in top face and adjacent to shank in under face of head.

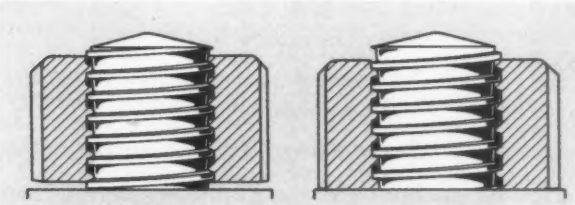
PLASTIC BOLTS



North American Aviation, Inc.

Because of their light weight, plastic bolts are used as tie-down and mooring fittings in aircraft. They are molded from cord-filled phenolic material.

SELF-LOCKING SCREW THREAD



Dardelet Threadlock Corp.

Slope on the root of the bolt thread tapered 6 deg. with the axis of the screw thread opposes a like slope on the ridge of the nut thread. When unlocked the nut turns freely, but when the nut meets the work the ridge of the nut thread is forced upward until the two slopes wedge.

SPRING FASTENER

Stamped out of SAE 1075 steel and then austempered this type of spring fastener is designed to assure almost 360 deg. engagement. Wide bearing area makes it particularly useful for assembly of plastic parts.

Adel Precision Products Corp.

INDEX TO ARTICLES ON FASTENINGS THAT HAVE APPEARED IN PRODUCT ENGINEERING IN RECENT YEARS.

Strength of Screw Threads Under Tensile, Fatigue and Impact Loads ..... Nov., 1939, pp. 475-479.

Wrench Clearances (Reference Book Sheet) ..... Oct., 1940, pp. 463-464.

Fastenings Designed for Speedier Production ..... Apr., 1941, pp. 202-203.

Wrench Clearances Required for Bolting Up Pipe Flanges. Mar., 1942, pp. 154-156.

Riveted Fastenings ..... Aug., 1942, pp. 446-450.

Design of Highly Stressed Studs to Improve Their Fatigue Strength ..... May, 1943, pp. 288-290.

Modified Standard Thread for Primary Aircraft Structures. Oct., 1943, pp. 641-642.

Torque-Stress-Load Relationship in Bolts and Scews (Reference Book Sheet) ..... Nov., 1943, pp. 752-754.

Wrench Torque Nomogram for Aircraft Nuts ..... July, 1944, pp. 503-504.

Standards for the Acceptance or Rejection of Driven Rivets. Sept., 1944, pp. 628-631.

ASSOCIATIONS THAT CAN FURNISH USEFUL INFORMATION ON FASTENINGS

American Institute of Bolt, Nut & Rivet Manufacturers ..... 1550 Hanna Building, Cleveland 15, Ohio.

Machine Screw Nut Bureau ..... 53 Park Place, New York, N.Y.

National Screw Machine Products Association ..... 13210 Shaker Square, Cleveland, Ohio.

Plain Washer Manufacturers Association .... 2100 S. Bay St., Milwaukee, Wis.

Sheet Metal Screw Statistical Service ..... 53 Park Place, New York, N. Y.

Socket Screw Products Bureau ..... 53 Park Place, New York, N.Y.

Spring Washer Institute ..... 74 Trinity Place, New York, N.Y.

Tubular & Split Rivet Council ..... 53 Park Place, New York, N. Y.

U.S. Cap Screw Service Bureau ..... 53 Park Place, New York, N.Y.

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U.S. Wood Screw Service Bureau ..... 53 Park Place, New York, N.Y.

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THE FAR EAST

Frontier for American Enterprise

IN THE great tradition of America, our frontier lies to the West. But for a United States that stretches from the Atlantic to the Pacific, to Go West is to arrive in the Far East. The feet of literally millions of our young men are now set upon that route.

Accomplishment of their objective—the defeat of Japan—will not end our responsibilities to the Orient any more than the defeat of Germany will end our responsibilities to Europe. This time we mean to see the venture through.

The first sketch of a political program for enlisting the strength of nations of good will to enforce the peace was drawn at Dumbarton Oaks. That is a good start. But those who participated know how much work remains before the blueprint becomes a fully matured plan, the plan becomes a structure, and the structure takes life and effective being in the living imagination and will of the peoples of the world.

No political accord, however high its purpose, can endure for long if it depends upon the loyalty and support of populations embittered by hopeless poverty that is offered no promise of relief. The poisonous dust of mass despair makes inevitable an ultimate explosion, whether it be sparked by a torch supplied from without or by its own internally generated heat. Much of the Far East is sufficiently close to that position to pose a grave problem to the Western world. It is of particular importance that American business men and workers alike recognize the nature of their responsibility in the matter, for to them the great area of the East presents also an opportunity and a challenge.

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The Orient—stretching in a vast semicircle from Manchuria and Japan to India and Ceylon—is the home of more than a billion people, the world's greatest potential market. In its mountains are the earth's richest stores of tin and mica; its deposits of iron ore, coal, and manganese rival those of France, Russia, and the United States. Its rice paddies are the most productive in the world, its coconut and rubber plantations the largest, and its cotton production is of major volume.

And yet, this fabulous region—with its riches of manpower and raw materials—suffers from living standards at the lowest rung of the world scale. With as much as 85 per cent of the populations of this great area devoted to the production of farm products, starvation has been an endemic plague to countless millions of its inhabitants, and will remain so until they graduate from the crudely primitive methods of the crooked stick and the bamboo plow to the use of the implements of a modern world in both agriculture and industry.

The improvement of agricultural methods and the burgeoning of industrial development depends upon tools—a preponderance of simple tools, no doubt, at the beginning, for modernization of economic processes is a development that cannot be forced at a rate faster than the ideas upon which they depend can be developed. If we, in the United States, are to hope to supply a major portion of the implements upon which the salvation of the East depends, we must be prepared to export also the skills and technologies which will make their effective use possible.

The possibility of a world market for machinery and manufactured products is a challenge that American industry cannot afford to ignore. The United States will emerge from the war with almost half of the world's industrial capacity within its borders, with much more than half of the heavy industries. Drastic and painful readjustments are inevitable; but they can be mitigated to the extent that we can find outside markets for the products for which we have excess capacity.

We shall find ourselves, at war's end, in a singularly favored position to compete in any equipment markets which are open. It is not merely that we shall have the productive capacities crying for outlets. Aside from Germany and Japan, which for some time will not be in a position to compete, our two major industrial Allies, Great Britain and Russia, will face enormous tasks in providing for their own rehabilitation. Neither of them is likely to be in a position to export more capital than they absorb; and although Canada, Sweden, and Switzerland will be, the United States will stand alone as the one major creditor nation in the world. If the potential advantages of this position are managed with wisdom and imagination, they will enormously enhance our opportunities for supplying a great share of the capital goods demand of undeveloped areas.

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What is the dimension of the Far East's potential demand? What are some of the difficulties standing in the way of its being realized?

If needs were the only measuring stick, the Far Eastern market would provide a bottomless pit into which even the great stores of our exportable capacity could be poured with room to spare.

China, alone, with its teeming population of 450 millions, has spelled out needs in dimensions large enough to stir the imaginations of the equipment producers of the world.

Business Week (February 5, 1944) supplements Dr. Sun Yat-Sen's spacious first estimates of the requirements for a thorough-going industrialization program with figures provided by current Chinese planners—25,000 locomotives; 300,000 freight cars; 20,000 passenger coaches; 20,000,000 tons of steel; and 90,000 power driven machine tools for the first five years of reconstruction. An American manufacturer of farm equipment, who recently surveyed the agricultural requirements of China, estimates an ultimate Chinese market for 20,000,000 tractors.

India's drawing-board plans are equally expansive. According to the bold pattern drawn up by a group of Bombay industrialists—some of whom are due to visit the United States early in 1945—India, after the war, will require a capital investment of $2,000,000,000 a year over the next 15 years, of which $250,000,000 per year for the first seven years will be in the form of imported capital goods.

Included on the huge import order list of the Bombay executives are mining, roadbuilding and power station equipment, heavy locomotives, metallurgical plants, agricultural machinery, and a long list of machine tools.

There can be no question of the need of these countries for the industrial equipment—and for many items of manufactured goods—which we are so eminently in a position to supply. But realism requires that we measure this demand against the Far East's probable capacity in the relatively near future to absorb industrial goods.

A Chinese economist has estimated that China, in 1937, had a total industrial capital investment of about $1,000,000,000 in American values, or something like $2.50 per capita of population. In contrast, the American investment, in manufacturing facilities alone, is now more than $600 per capita.

What it could mean in terms of capital goods requirements if China alone carries out this dream of modernizing, not to the utopian level of the United States but to the present modest level of the less developed Soviet Union, is typified by measuring just three lines: 500,000 tons of steel a

year, for five years, to add 12,500 miles to the railroad system; 2,187,500 motor vehicles; 3,300,000 telephones.

But it is one thing to cite mountainous figures demonstrating needs. It is another, and far less optimistic exercise, to find assurance that practical opportunities for satisfying such needs can be made to materialize. Let us face some of the major difficulties and see if they are insurmountable.

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The first hurdle to be cleared is the question of whether or not we want to promote the industrialization of the Far East. The wisdom of doing so has been vigorously challenged. The negative argument, on the economic side, generally runs thus: If we provide industrial equipment to backward economic areas, we deprive ourselves of the greater long-run opportunity of selling them manufactured articles which our aid has enabled them to produce for themselves.

It is only fair to say that such a thing might happen—that it has happened in isolated instances in the past. But the overwhelming weight of economic history demonstrates that the broader attitude is also the profitable one.

The United States itself is the living refutation of the fear which now cramps the outlook of many of its own citizens.

From 1790 until 1850 the foreign trade of our new fledged Nation had many of the characteristics which pertain to the trades of China and India today. We imported manufactures and we exported raw materials, agricultural products, and newly mined gold. Our imports exceeded exports, the difference being made up partly by payments to us for shipping services and partly by industrial development loans. It is relevant to inquire how the trade of the lenders was affected by this policy of supplying us with industrial capital and machinery.

From 1850 through 1939 the pattern of America's foreign trade changed. Slowly at first, and then at accelerated pace, our import ledger showed a percentage decline in manufactured goods and a percentage rise in raw materials to feed our expanding industrial facilities. But while finished manufactures declined percentagewise in our import budget, so great was the increase in our total foreign trade operations in the century from 1830 to 1930 that our imports of manufactured goods increased more than twentyfold, and they more than doubled between 1900 and 1939.

Clearly industrial Europe gained rather than suffered from the industrialization of the United States, and it is equally clear that we, in turn, shall benefit from the industrialization of the world's undeveloped territories. Further evidence is provided by Canada which, with its high industrial development but only 12 million people, buys from us each year almost as much as the relatively unindustrialized 130 million people south of the Rio Grande.

If it be granted, as I believe it must, that the development of Far Eastern countries will be to our advantage as well as theirs, the second question that we should face is the speed with which it can be accomplished. Is there genuine promise in the proximate future of opportunities for American enterprise of the magnitude set forth in the estimates quoted above?

In all fairness, I am forced to state my conviction that the road is longer than is indicated by Chinese and Indian leaders. It is natural, and far from censurable, that their eyes should be focussed upon the urgency of national needs, rather than upon obstacles in the way of their fulfillment.

On the other hand, it is possible that our own long process of industrialization may lead us to conclusions of undue conservatism. Ideas, once they break the crust of resistance are the most contagious of bacteria, and the tempo of their infiltration seems to increase by geometrical progression in a world of swift communication.

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In an interesting recent study of The International Labor Office, it is suggested that the general economic level of the rest of Asia outside Japan in the late 1930's was not dissimilar to that of Japan in 1900. Between 1900 and 1936, Japan increased its total capital investment more than threefold devoting between 10 and 17 per cent of its annual income to capital outlays. A comparable tempo of development for China, India, and other Asiatic areas would result in a capital expansion that would dwarf to insignificance the most optimistic blueprints that have been put forth to date. I am not suggesting this as a likely possibility, but rather as a caution lest we, in the name of hard-headed realism, underestimate Asiatic potentials as much as their own nationals exaggerate them.

Finally, in appraising the outlook for American enterprise in Far Eastern markets, we collide, head-on, with the problem of how we are to be paid. Here, hard-headedness can be only a virtue, for the lack of it will breed inevitable disaster for the Asiatics as well as for us.

In the last analysis, the dimension of the American market in the Far Eastern countries will be determined by the dollar exchange at their command, obtained through the products, goods, and services which they are able to provide to us, with due allowance for multilateral trade arrangements. It is true that the balance temporarily can be distorted through the extension of developmental loans. There is little question but that such loans will be in order after the war, and if they are wisely made, for productive projects that eventually will increase the exporting capacities of the countries to which they are extended, they can be thoroughly justified. But the best loans provide only a temporary expedient. In the long run, the balance of current payments must be restored with sufficient margin to provide interest payments and finally amortization of principal.

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How, then, are we to attack the problem of increasing our imports from the Orient?

In 1937, the total exports of the Far East amounted to something over $5,000,000,000—a little less than $1,500,000,000 in foodstuffs, a little more than $2,500,000,000 in raw and partly manufactured materials, and better than $1,000,000,000 of manufactured articles. Of this total, the United States purchased only about 20 per cent—approximately 10 per cent each of the foodstuffs and manufactures, and 30 per cent of the materials.

Despite changes in our technologies which will probably reduce our future takings of such important items as rubber and silk, the achievement of a high level of economic activity in this country after the war will provide a basis for increasing our Eastern imports, but only if it is an accepted part of our national policy to do so.

This means an alert and aggressive exploration of two-way trade possibilities on the part of both American business and our governmental agencies. It cannot be done by either alone.

The war has dislocated many of the trade patterns that prevailed in the past. The East is hungry for the type of products which we, uniquely, are situated to supply, but it will make its bargains with those who will not only fill its needs but will also provide outlets for its produce. Even the prewar magnitude of the exports from this area provides ample margin for the most meticulous and imaginative shopping of Eastern markets with the aim of increasing the modest share of our prewar purchases. And a farsighted program of development loans can greatly increase the capacity of these countries to produce what we want.

In general, we can trust American enterprise to explore rigorously all likely export opportunities. But the equally vigorous investigation of import possibilities will require a break from past traditions on the part of American business and American government.

Both East and West must learn to think in new patterns for the successful opening of a new frontier.

President McGraw-Hill Publishing Co., Inc.

Electrical Equipment Developments As Influenced by Aircraft Design

LT. COL. T. B. HOLLIDAY
Engineering Division, Equipment Laboratory, Wright Field

Progress in aircraft electrical equipment which has resulted from requirements of weight, space, reliability and operating conditions. Recent developments in the design and performance of airborne engine generator units, ground power units, batteries and control accessories are summarized. Trends are projected which promise further improvement.

THE progress in aircraft electrical equipment can be described in three words—appendage, convenience, necessity. Yesterday the electrical system was an appendage, not particularly useful and certainly one on which the airplane did not depend. Today it is a convenience. Tomorrow it will be a necessity.

Fortunately the electrical industry has kept pace with the needs of aircraft designers. Electrical and mechanical engineers have created seeming miracles of design in answer to new problems as they arose. With each problem, the aeronautical engineer included requirements covering weight, space, reliability and operating conditions.

Answering the needs of these requirements was far more difficult than solving problems dealing with mechanisms. All of these requirements have not been properly appreciated in the past. So far as the electrical engineer is concerned, this is particularly true with reference to reliability and operating conditions.

Requirements for minimum weight and space are emphasized when some well-known facts are reiterated. In a transport airplane a pound saved is worth its weight in gold. Air express charges from coast to coast are approximately $1.00 per lb., an airplane can make 20 such trips per month and the life of the airplane certainly exceeds five years, therefore, a wasted pound is theoretically worth $1,200.

As the size of an airplane increases, the weight of fuel to be carried for a given trip becomes a larger portion of the total weight. To support an extra pound of equipment, and the extra fuel to carry it, an additional one-half pound of structure is required. In long range aircraft the wasted pound can cost as much as two and one-half pounds.

Space, like weight, must be held to a minimum. The size of the fuselage is determined by the things that go into it. The aeronautical engineer holds the fuselage cross-sectional area to a minimum because that governs the power which must be used to drag the fuselage through the air. If more power is needed, more fuel must be carried and the weight of the airplane goes up. If more space is needed, more structure is needed and the weight goes up. Weight and space are like Siamese twins. If the engineer makes a concession to one, he must do likewise for the other.

Maximum reliability and minimum weight are probably at opposite poles in the field of design. To obtain either the designer must sacrifice the other. This is probably the only concession that the areonautical engineer will make to the equipment engineer, because more and better service is given to an airplane than to any other means of transportation. An airplane is kept in the air as much as possible. Between flights it is inspected. At regular intervals of 25, 50, 100 or 500 hr. it receives varying degrees of inspection and maintenance so that equipment can be operated much closer to its design life than is possible in other services.

Even with this compromise it is difficult to define an adequate degree of reliability. The designer should assume that electrical equipment will receive no attention for 1,000 hr. He should also aim for a total life of at least 5,000 hr., meaning that minor replacements and renovating maintenance can be made at four or five intervals of 1.000 hr. each. As a concession to weight this is a minimum, more is desirable. But it must be remembered that during a thousand hours of flying the airplane operator expects utter reliability.

Operating conditions, the fourth requirement, is emphasized by the airplane's ability to do much in little time. Engineers must design aircraft equipment for operation at any time, at any part of the world, including all altitudes from sea level to the highest attainable. Operating conditions can be broken into eight parts so far as the electrical engineer is concerned.

1. Altitude. To keep ahead of the progress in aviation the engineer should strive for a working altitude of 50,000 ft. Air density at this height is about one-fifth that at sea level. Also, the atmosphere is dry, and the ionizing potential is much less than moisture-laden air at sea level. Proper cooling, adequate insulation and arc-less commutation are difficult to achieve.

2. High Temperature. To insure proper operation in any climate, electrical devices must be designed to operate at 165 deg. F. This represents an atmospheric temperature of approximately 130 deg. F. and a 35 deg. F. temperature rise when the airplane is parked in the sun.

3. Low Temperature. Temperature on the ground will seldom be lower than −65 deg. F. At high altitudes over the tropics it may be as cold as −100 deg. F. In one flight, the highest and the lowest temperatures can be encountered. In flight there is no opportunity to change lubricant or make other adjustments for temperature.

4. Vibration. In any airplane, every device will be operated at its critical frequency at some time. The range of frequencies is large because of many contributing factors such as power impulses of the engines, air pressure fluctuations as the propeller blades pass the wing and fuselage, and the resonant vibration of portions of the aircraft structure. To be safe the designer should test his product at all frequencies from 10 to 50 cycles per sec. and at amplitudes that will result in accelerations of at least 10 gravity.

5. Sand and Dust. Everyone knows that there is sand in Africa, but few

know that there is a hard ferrous sand in the Aleutians. Fine sand can be encountered at 20,000 ft. over Africa and dust has too often been found at 10,000 ft. over Kansas. Wherever found, sand and dust are implacable enemies of electrical apparatus, they cause friction and wear in pivots and moving surfaces, hold relay contacts apart, make meters inaccurate, and shorten the life of equipment.

6. Humidity. In tropical climates the relative humidity stays near saturation at all times. Untreated fabrics will rot in a few days. Some types of insulation will fall off wiring. Fungi of various types grow in all possible places; in one instance fungus growth interfered with the operation of a small switch that was thought to be totally inclosed. One type of fungus will etch glass. Under high humidity, unprotected wiring in the smaller sizes will corrode and cause an open circuit. To be sure that his design is correct the engineer should expose his product to at least 30 days of high humidity at approximately 95 deg. F. and in the presence of as many types of fungi as can be found.

7. Salt. Salt laden moisture will corrode and short-circuit practically any piece of electrical apparatus in a short time. The favorite victims of this operating condition are two unlike materials that are in close contact. This is a hardship to the engineer who is working on aviation equipment because the two light metals, aluminum and magnesium, are very susceptible to corrosion, and the most popular conductor, copper, is at the other end of the potential scale, so that it is difficult to use these materials in close proximity.

8. Radio Noise. Electrical devices must be designed to interfere as little as possible with the reception of complicated and sensitive radio instruments that are installed in aircraft.

The source of electrical power in an airplane during flight is the engine driven generator. For years this generator has been confined to a space 6½ in. in diameter by about 14 in. in length. The operating speed has been 2,500 to 5,000 r.p.m., but efforts have recently been made to lower the minimum speed to 2,000 r.p.m. Engine designers have been asked to alter new designs to permit a generator operating speed of 4,000 to 10,000 revolutions per minute.

Prior to 1940 the operating voltage of the generator was 15 volts. Since then it has been 30 volts. For many years the generator has been rated in terms of amperes. Efforts to make successive ratings double that of the next smaller have resulted in ratings which have proceeded from 25, through 50 and 100 to 200. Now 400 is being studied. All increases in rating had to be achieved without increase in the dimensions allowed.

This progress is shown by the curves of Fig. 1. In the last five years the normal output of generators has been increased in a ratio of 16 to 1 without an increase in space.

The specific weight in lb. per kw. has been lowered from more than 40 to four. While the cost of materials and labor has increased because of wartime demands, the cost per kw. has dropped from a depression low of $50 to $30. The cost per lb. has risen from $1.50 to approximately $5.00. This is reasonable since the average cost of an airplane is about $5.00 per lb. Military aircraft often exceed this cost because of the emphasis on performance.

A typical generator, a voltage regulator and a reverse current relay switch are shown in Fig. 2. The duct at the commutator end of the generator, Fig. 2(*A*), for admission of forced air, con-

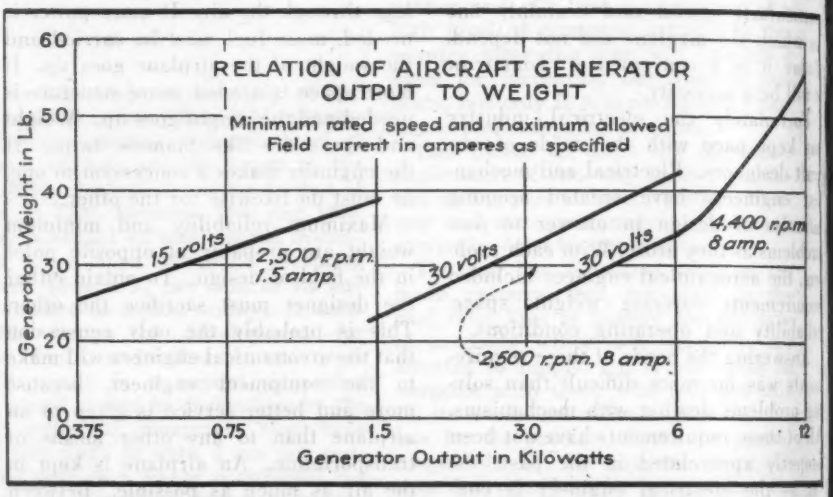


Fig. 1—Progress in increasing the output of generators. Curves show how specific weight in lb. per kw. has been lowered.

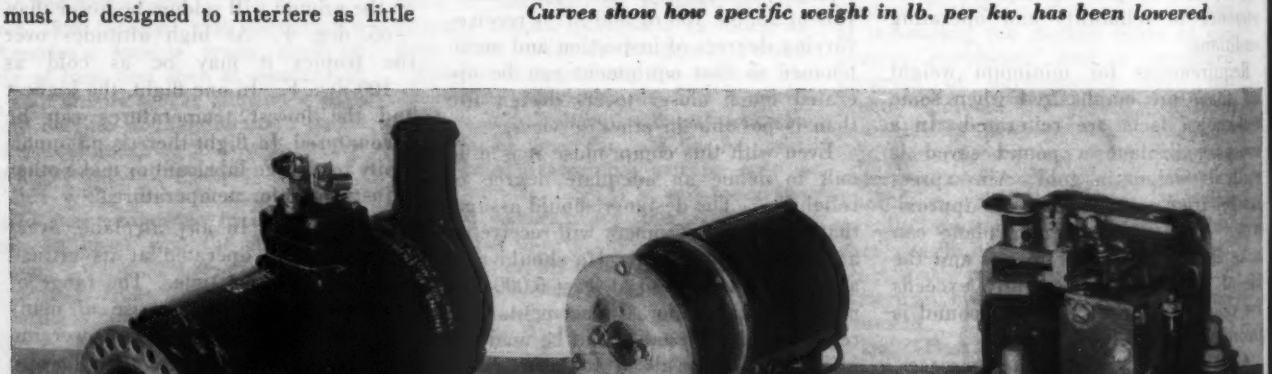
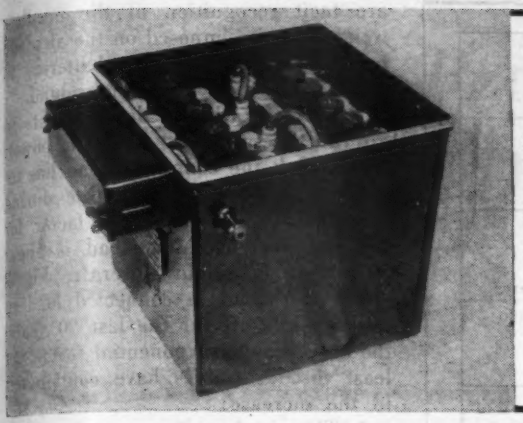


Fig. 2—(A) Six kilowatt aircraft engine driven generator. The duct at the commutator end of the generator is for admission of forced air. (B) Carbon pile voltage regulator. (C) Reverse current relay for aircraft generator.



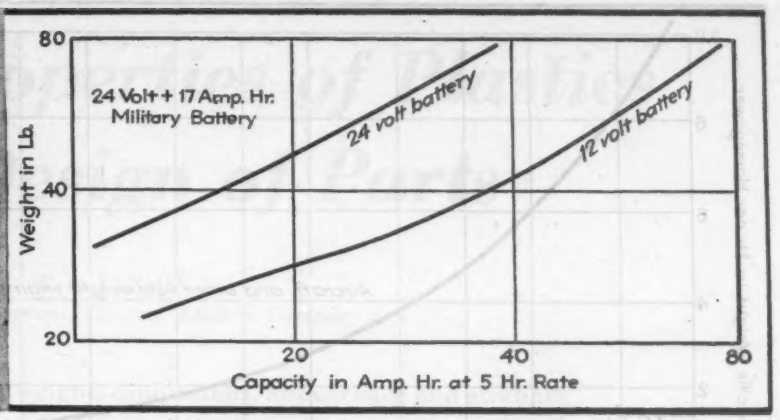


Fig. 3 (Left)—Battery of 24 volt, 34 ampere-hour, for aircraft. When the battery is inclined at an angle of more than 45 deg., cone-shaped lead plugs close the apertures to the cells. Fig. 4 (Right)—Curves for weight and performance of 12 and 24 volt batteries.

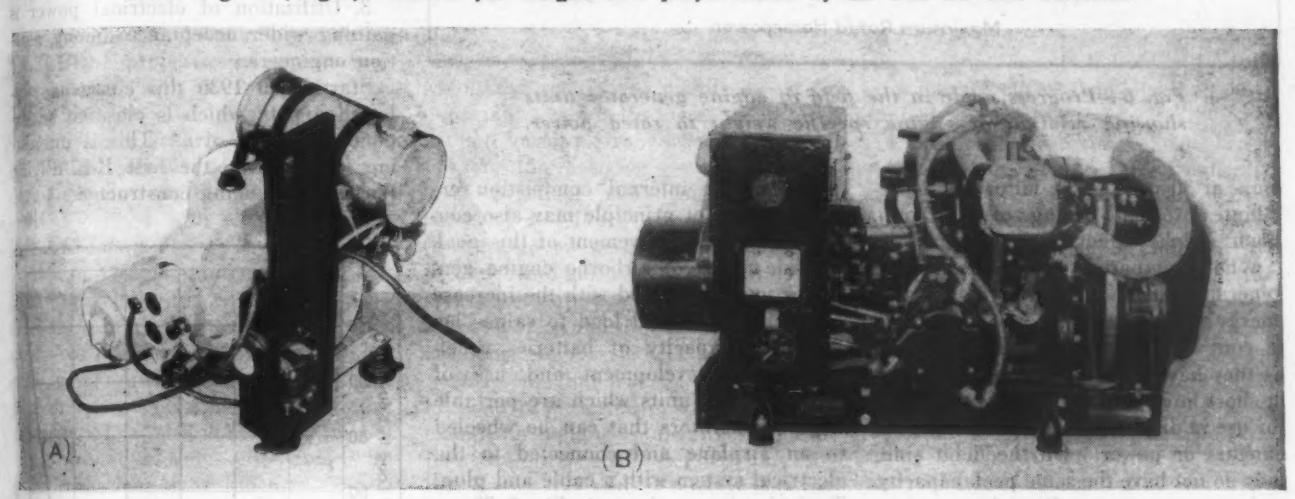


Fig. 5—(A) Aircraft auxiliary type C-7 power plant, 30 volts, 70 amp. (B) Aircraft auxiliary power plant, 30 volts, 175 amp., with five-minute overload rating of 260 amperes.

nects with a two-inch duct pointed forward in the slip-stream. The air is exhausted at the mounting flange end. The design is based on a differential pressure of 6 in. of water across the ends of the generator.

The commutator, probably the most critical point in the machine, contributes nothing to the output of the generator, therefore, it is desirable to reduce the weight of the commutator to a minimum. The obvious answer is to increase brush density; 40 to 60 amp. per sq. in. are conventional values for brush densities, but aircraft generators are operated at densities which exceed 200 amp. per sq. in. at rated load. With cooling, brushes can carry 150 percent of rating for five minutes. If adequate cooling was available, the density could be doubled.

The voltage regulator deserves a little praise for an "assist" in the generator program. One obstacle in the early generators was the low current rating of the Tirrill or vibrating contact regulator. This regulator is widely used in automotive practice and is quite satisfactory at currents of less than 1.5 amp. and voltages of less than 20 volts, To reduce generator weight the field current had to be increased. This put more load on magnetic sections and permitted a reduction in magnetic and copper length. The regulator shown in Fig. 2*(B)* is a carbon pile, it can control generators having maximum field current requirements of less than 9 amp. This corresponds to a field winding resistance of approximately three ohms. The regulator weighs less than three pounds and must dissipate approximately 75 watts at the peak point which occurs at a field current of about four amperes. To accomplish this, the radiating surface is finned.

Aircraft batteries, the reservoirs of the electrical system, are of the lead acid type. Again life and reliability have been sacrificed to obtain minimum weight. Even then no startling achievements have been made.

A 24 volt battery is used with a 30 volt generator, thus the designation "24-30 volt system."

A typical battery unit is shown in Fig. 3. Some departures from industrial practice are evident. Since an airplane can be flown in an inverted position, the cell plugs must prevent the leakage of electrolyte in such flight. When the battery is inclined at an angle of more than 45 deg., cone-shaped lead plugs close the apertures to the cells. Forced ventilation carries away the accumulation of gases in the top of the battery and discharges them into a sump where a neutralizing powder counteracts the acid.

Weight and performance data of batteries are given in Fig. 4. These differ little from similar data that could have been prepared years ago. Despite thin plates, shortening of battery life and other tricks of the designer's art, the storage of one kwh. of electricity costs 100 lb. In gasoline the same amount of energy is stored in ¼ pound.

Because the battery is heavy, efforts have been made to find a substitute. A logical answer is the engine generator unit. Much progress has been made in this field. It is now possible for one man to carry a 15 hp. engine. Two popular versions of this power plant are shown in Fig. 5. One has a continuous rating of 70 amp. and the other of 175

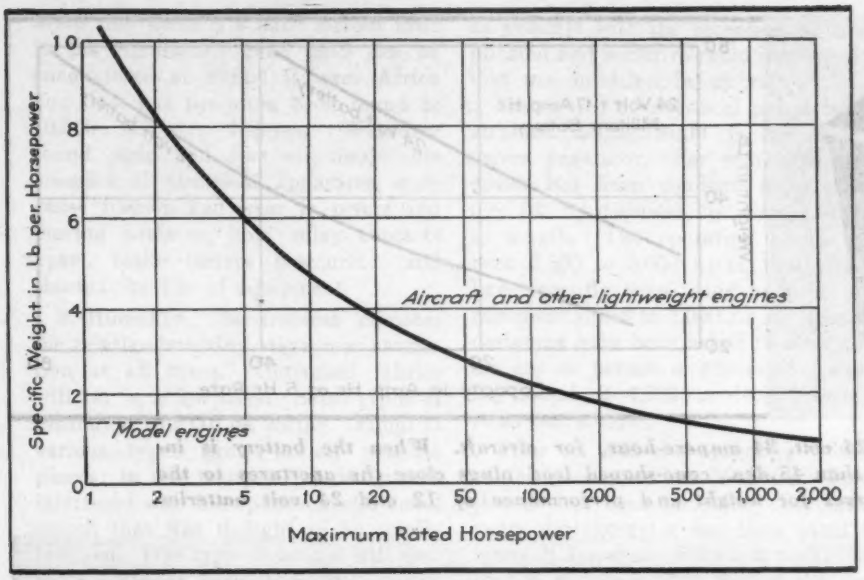


Fig. 6—Progress made in the field of engine generator units showing relation of engine specific weight to rated power.

amp. at 30 volts. The latter has a five-minute overload rating of 260 amp. Each weighs about 120 pounds.

When compared with batteries the generator units weigh less for the same energy rating, are not as susceptible to cold weather, will function as long as they have fuel, require less attention at short intervals, and are more suitable for use in dispersed revetments far from hangars or power. On the debit side, they do not have the same peak capacity and are more complicated.

Progress made in the field of engine generator units is shown in Fig. 6. There is still room for more progress as this diagram shows. It is possible to build tiny engines for one lb. per hp., and it is also possible to build large aircraft engines for the same specific weight. To achieve this weight at intermediate power levels it will probably be necessary to use the two-cycle principle for internal combustion engines. The jet principle may also contribute to the achievement of this goal.

Wide usage of airborne engine generator units combined with the increase of aircraft electrical load to values beyond the capacity of batteries accelerated the development and use of ground power units which are portable engine generators that can be wheeled to an airplane and connected to the electrical system with a cable and plug. Typical units are shown in Fig. 7. These ground power plants differ from the airborne units in that they are heavier and more rugged. The use of available engines that have been developed for other purposes is responsible for some of the weight. The ground power units are the answer of the military services to a problem that caused the development of "battery carts" by the airlines. Both serve the same needs and both are tacit recognition of the needless weight penalty imposed on the airplane by the use of sufficient batteries to care for idle periods on the ground.

Practically all new developments in aircraft accessories use electrical power. As a result the connected load has increased at an astounding rate during recent years. The demand factor for the electrical accessory load is about 50 percent in military aircraft. Fig. 8 shows the trend in connected load in military aircraft for the last 20 years, the curve has an exponential form. At least three variables have contributed to the increase:

1. The number of accessories is increasing.
2. The size of airplanes is increasing.
3. Utilization of electrical power is gaining wider acceptance among aviation engineers.

Starting in 1936 this curve has followed a path which is close to an exponential curve of n^3. This is interesting, for in 1936 the first B-17 Flying Fortress was being constructed.

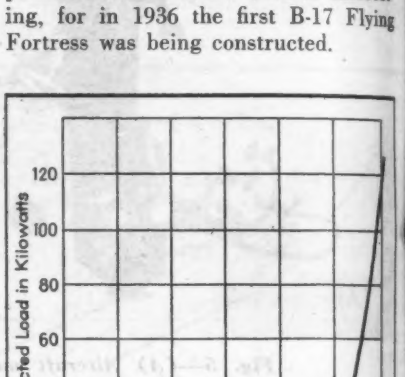


Fig. 8—Trend in increase of connected electrical load in aircraft in 24 years.

Fig. 7—Ground power units. (A) Rated at 30 vo lts, 70 amp. (B) Rated at 30 volts, 200 amperes.

Chemical Properties of Plastics Affect Design of Parts

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Effect of various reagents on weight, dimensions, appearance and strength of principal plastic materials is described in this article to aid in better design of plastic parts. Standard and supplementary reagents are listed.

THOSE properties of plastics concerned with the ability or the inability of a given material to enter into a chemical reaction are known as chemical properties. Thus, they are distinguished from the physical properties associated with electricity, heat, light and sound.

From a design standpoint, the "inability" to enter into a chemical reaction—the chemical resistance, in other words—of the plastic is of greatest concern. Study of this property shows that there are phenomena involved which are not part of a chemical reaction but which are so closely associated with it that a distinction is difficult. Typical of these are moisture absorption, solvent action, aging and weathering, taste and odor characteristics and fungi resistance. Although these characteristics may not come under the formal definition of chemical properties it is, nevertheless, the most convenient and the most logical place to discuss them.

From a theoretical standpoint, pure water could have the following effects on a plastic:

1. Enter the material by capillary action and diffusion in a purely mechanical manner.
2. Dissolve or partially dissolve one or more constituents of the material by solvent action.
3. Enter into a chemical reaction, such as hydrolysis, with the material to form one or more new materials.

These actions may go on singly or simultaneously, and the rate at which they proceed will be affected by temperature and pressure.

In a similar manner, all of the chemical reagents considered here, whether pure or in a water solution, will affect the plastic material in much the same way. Thus, a problem involving chemical resistance should be analyzed for each type of effect and for each reagent involved. The tendency of a particular reagent to shrink or to leach a plastic sample can be offset by the water in which the reagent is dissolved. It is important to evaluate these test results without forming erroneous conclusions.

From the designer's viewpoint, the most practical measuring sticks of chemical resistance are the effects of the reagent on weight, dimensions, appearance and mechanical strength. More specialized applications, such as the effect on electrical properties, haze value and abrasion resistance, are also frequently of importance. These must necessarily be tested individually. The change in weight is usually irrelevant in actual design and service, but this increase or decrease is often a good indication of the over-all effect of the reagent.

The tentative test standard of the A.S.T.M. for measuring chemical resistance involves the immersion of a strip of the material 3x1x⅛ in. or a molded disk 2 in. in diameter and ⅛ in. thick in the reagent for 168 hr. at 25 to 30 deg. C. The standard and supplementary reagents that have been selected are listed in the accompanying table. They are representative of many of the service applications of plastics and are also representative of many types of chemicals.

Although the data determined from this test and listed in the table on the following page may be consistent and accurate in its particular field, the A.S.T.M. recognizes the limitations of the test and recommends that the results be used only for comparison or for the selection of likely materials for further test. The following conditions are typical of those which may radically change the chemical resistance of a particular material to a reagent:

1. The reagent may be more active in higher or lower concentrations.
2. The effects may be advanced or retarded by changes in temperature or pressure or by the effect of a catalyst or sunshine.
3. Reagents which have no apparent effect when tested individually may show marked effect when mixed or when applied successively.
4. The immersion time of 168 hr. is comparatively short and frequently marks only the beginning of an action. Special cases and supplementary information to that presented in the table follow under the headings of the more common plastic materials.

Phenolics

The chemical resistance of phenolics is complicated by the various types of fillers which are employed in molded and laminated parts. The filler will not improve the chemical resistance of the resin but rather will detract from the resistance of the compound by absorbing the reagent or by having poor resistance in itself. Thus, fabric-filled molded phenolic and laminated phenolic will be more susceptible to the action of chemical reagents because of absorption of the reagent into the fibers of the filler. Inorganic fillers with low water absorption, such as asbestos, therefore, give maximum protection to the resin and to the molded part. Those phenolic molding compounds which are classed as chemical resistant are generally filled with either asbestos, graphite or mica. These special formulations show improvement over the general-purpose material evaluated in the table to the extent that the most severe reagent, 10 percent sodium hydroxide, causes only a 5 percent increase in weight, a 5 percent swelling and a 50 percent drop in strength after six months of exposure. Other reagents showed little effect other than surface attack.

Most phenolic molding compounds are made by a two-stage process employing the addition of hexamethylenetramine, known as hexa, in an intermediary step. This agent is responsible for the liberation of ammonia in the molded phenolic material. Under unfavorable

Effect of Various Chemical Reagents on Representative

	Molded Phenolic, General Purpose				Laminated Phenolic, Paper Base				Molded Urea				Cast Methyl Methacrylate		
	(1)	(2)	(3)	(4)	(1)	(2)	(3)	(4)	(1)	(2)	(3)	(4)	(1)	(2)	(3)
30 percent sulfuric acid	+M	+M	A	Y	+N	+M	A	Y	+N	+N	A		+N	+N	N
3 percent sulfuric acid	+M	+M	A	Y	+N	+M	A	Y	+N	+N	A		+N	+N	N
10 percent sodium hydroxide	+E	+E	E	Z	+E	+E	E	Z	+N	+N	N		+N	+N	N
1 percent sodium hydroxide	+M	+M	A	Y	+M	+M	A	Y	+M	+N	N		+N	+N	N
95 percent ethyl alcohol	—N	+N	N		+N	+M	N		—N	+N	N		+E	+E	A
50 percent ethyl alcohol	+N	+M	N		+N	+M	N		+M	+N	N		+M	+M	A
Acetone	—N	+N	N		+E	+E	A		—N	—N	N		D	D	D
Ethyl acetate	—N	—M	N		+N	+N	N		—N	—N	N		D	D	D
Ethylene dichloride	—N	+N	N		—N	+N	N		—N	—N	N		D	D	D
Carbon tetrachloride	N	+N	N		+N	+N	N		+N	+N	N		—E	—M	A
Toluene	+N	+N	N		+N	+N	N		+N	+N	N		D	D	D
Heptane	—N	+M	N		N	N	N		—N	+N	N		+N	—N	N
10 percent sodium chloride	+N	+N	N		+M	+M	A		+M	+N	N		+N	+N	N
Distilled water	+N	+N	N		+M	+M	N		+M	+M	N		+N	+N	N
10 percent nitric acid	+M	+M	A	Y	+M	+M	A	Y	+M	+N	A		+N	+N	N
10 percent hydrochloric acid	+M	+M	A	Y	+M	+M	A	Y	+N	+N	A		+N	+N	N
5 percent acetic acid	+M	+M	N		+M	+M	A		+N	+N	N		+N	+N	N
Oleic acid	+N	N	N		+N	+N	N		+N	+N	N		+N	+N	N
Ammonium hydroxide	+M	+M	C		+M	+M	A		+M	+N	N		+N	+N	N
2 percent sodium carbonate	+M	+N	N		+M	+M	C		+M	+M	N		+N	+N	N
3 percent hydrogen peroxide	+M	+N	N		+M	+M	N		+M	+N	C		+N	+N	N

(1) Weight
N — Negligible change; under 1 percent
D — Dissolves
M — Slight or moderate changes
E — Extreme changes

(2) Dimensional
N — Negligible change; under 1 percent
D — Dissolves
M — Moderate changes
E — Extreme changes

conditions, such as high heat and humidity, this ammonia is liberated, often with harmful effects in respect to odor and corrosion. Typical applications in which this trouble has been experienced are molded instrument cases, refrigerator controls and housings for delicate radio apparatus. This source of trouble can be eliminated by using a phenolic resin made in one stage which does not use any hexa. A "wet mix" compound is a material of this type. Laminating varnishes are also one-stage resins and are ammonia free.

Other than this difference in resins, phenolic laminated materials respond much the same as molded phenolics to chemical reagents. Laminating resins are slower to polymerize and test samples may show an appreciable attack by solvents such as alcohol and acetone. Strong acids and alkalies will attack the laminate and destroy its appearance and strength. Many corrosive and oxidizing reagents will attack the surface of the material without seriously impairing its mechanical strength. The use of sheet material in pumps, bearings, plating barrels, gaskets, rayon buckets and other parts in contact with chemicals has been tried successfully. In some instances, applications are made when chemical attack is obvious, but the useful life of the material is better than any other.

Urea and Melamine

Ureas are frequently used for closures, tableware, soap dispensers, buttons and packaging for cosmetics and drugs. As such, it is subject to chemical action and particularly to the repeated use of soap and water. Properly molded urea parts are not affected by immersion in water and in mild cleaning agents, but they will swell and check if improperly molded. If continually immersed, urea will approach 5 percent in water absorption and will swell appreciably. This swelling will cause cracking in heavy sections and in poorly designed pieces. Urea is considered particularly good in its resistance to greases, organic solvents and oils.

Available information on the chemical resistance of melamine indicates that it is completely resistant to tap water, soap solutions, methanol, butyl Cellosolve, ethylene dichloride, acetone, glycerine, xylene, 10 percent citric acid and 10 percent caustic soda. Concentrated ammonia will cause discoloration and 40 percent sulfuric acid causes bad discoloration and attack. Melamine shows more resistance to dilute acids and alkalies and is less affected by boiling water than urea.

Polystyrene

Polystyrene has the distinction of being one of the best plastics for all-around acid and alkali resistance. Concentrated sulfuric and nitric acid cause it to lose 20 percent of its strength, but this is the most severe effect of attack by the common acids and alkalies. Its ultimate water absorption over long periods of time is practically nil. Common solvents, in order of rapidity of action, are acetone, chloroform, methyl ethyl ketone, toluene, ethyl acetate, benzene and carbon tetrachloride. Applications of polystyrene include bottles and closures for acids, battery cases and grid clamps, refrigerator trays and bezels, liquor dispensers and perfume and cosmetic packages.

lastic Materials From Standpoint of Service Conditions

Polystyrene			Vinyl Chloride–Acetate Copolymer				Cellulose Acetate				Cellulose Nitrate				Ethyl Cellulose			
(2)	(3)	(4)	(1)	(2)	(3)	(4)	(1)	(2)	(3)	(4)	(1)	(2)	(3)	(4)	(1)	(2)	(3)	(4)
+N	N	N	+N	—N	N	N	+N	+N	A	Y	+N	+N	N	X	+N	+N	N	
+N	N	N	+N	+N	N	N	+M	+M	A	Y	+M	+N	N	Y	+M	+N	N	
+N	N	X	+N	—N	N	X	+E	+E	E	Z	—M	—M	A	Y	+M	+N	N	
+N	N	X	+N	N	N	N	+M	+M	A	Y	+N	—N	A	X	+M	+N	N	
+N	N	N	N	N	N	N	+E	+E	D	Z	D	D	D	Z	D	D	D	Z
+N	N	N	+N	N	N	N	+E	+E	D	Z	+E	+E	N	Z	+E	+E	E	
D	D	Z	D	D	D	Z	D	D	D	Z	D	D	D	Z	D	D	D	Z
D	D	Z	D	D	D	Z	D	D	D	Z	D	D	D	Z	D	D	D	Z
D	D	Z	D	D	D	Z	+E	+E	E	Z	+E	+E	D	Y	D	D	D	Z
D	D	Z	+N	—N	N	N	+M	+N	N	N	+N	+N	N	N	D	D	D	Z
D	D	Z	+E	+E	E	Z	+M	+M	N	Y	+M	+E	D	Y	D	D	D	Z
D	E	Z	—N	—N	N		—N	+N	N		+N	—N	N		+E	+E	E	
+N	N		+N	—N	N		+M	+N	N		+M	+N	N		+M	+N	N	
+N	N		+N	+N	N		+M	+M	N		+M	+N	N		+M	+N	N	
—N	N	N	+N	+N	N	N	E	E	E	Z	+M	+N	N	X	+M	+N	N	
+N	N	N	+N	—N	N	N	+E	+E	E	Z	+M	+N	N	Y	+M	+N	N	
—N	N		+N	—N	N		+M	+M	A		+M	+N	N		+M	+N	N	
+N	N		+N	—N	N		+N	+N	N		+N	+N	N		E	E	E	Z
+N	C		+N	N	N		+M	+E	A		—M	+M	A		+M	+N	N	
+N	N		+N	—N	N		+M	+M	A		+M	+N	N		+M	+N	N	
—N	N		+N	—N	N		+M	+M	N		+M	+N	N		+M	+N	N	

(3) Appearance
N – Negligible change
C – Discolored, dulled or yellowed
A – Attacked and roughened
D – Dissolves
E – Extreme attack

(4) Strength
N – Negligible loss
X – 0 to 20 percent loss
Y – 20 to 60 percent loss
Z – 60 to 100 percent loss

Methacrylate

The low concentrations of acids in the test reagents listed in the table are rather misleading in the case of methyl methacrylate. This material loses its strength and appearance when contacting concentrations above 40 percent sulfuric, 10 percent nitric, 50 percent acetic acid and 25 percent sodium hydroxide. It is also slightly attacked by gasoline which contains benzol or tetraethyl lead. These limitations do not affect its most widely used applications, however, and it turns in a good performance in such parts as dentures, brushes, electroplating masks and cosmetic containers which require moderate chemical resistance.

Cellulose Derivatives

Cellulose acetate is resistant to the aliphatic and aromatic hydrocarbons, and most of its chemical applications stem from this property. It is used for oil cans, tool and valve handles and for items requiring little solvent resistance. Cellulose acetate butyrate has slightly greater chemical resistance because of its decreased water absorption. This is also true of cellulose nitrate, which has comparatively good water resistance. Ethyl cellulose is noted more for its ability to be dissolved than for its solvent resistance. It is readily dissolved in the alcohols, esters, ethers, ketones, and the chlorinated and aromatic hydrocarbons to form various lacquers, coatings and cements. Its acid and alkali resistance lends it to normal applications such as tubing, wire insulation, packages and coatings. One of the outstanding wartime applications of ethyl cellulose has been the molding of Army canteens.

Vinyls

The copolymer of vinyl chloride and vinyl acetate has a resistance to acids and alkalis which is comparable to that of polystyrene. In addition, it is soluble only in ketones, esters, polyethers and the chlorinated hydrocarbons. This combination lends itself to a wide variety of applications, typical of which are molded insecticide sprayers, gasket material, extruded tubing and coatings and masking films for electroplating. Polyvinyl chloride, which constitutes up to 95 percent of the copolymer, is also recognized to have superior chemical resistance by itself. It is especially adapted to flexible wire coverings, calendered fabrics, extruded tubing and coatings that must be resistant to weathering and other forms of attack.

Polyvinyl alcohol is unique in being water soluble and at the same time possessing extremely good resistance to oils, fats, greases and most organic solvents. As a film, molding or extrusion it has been used for gloves, aprons, tubing and gaskets.

Vinylidene Chloride

Practically the only reagents in a widely assorted group, including those listed in the table, that are considered unsuitable for or detrimental to vinylidene chloride, or Saran, are ammonium hydroxide, dioxane, bromine and chlorine water, ethyl dichloride, diethyl ether and O-dichlorobenzene. Saran is extensively used for extruded tubing and pipe, and as such must be carefully investigated for possible corrosive chemical effects. Other applications are

spray-gun handles, valve seats and nozzle tips, spinnerette couplings, rollers and guides for rayon manufacture.

Nylon

Nylon is resistant to ordinary solvents, such as esters, ketones and alcohols, and to alkalies and weak acids. It is attacked by phenol, formic acid and concentrated mineral acids. Its moisture resistance is only fair and molded specimens exhibit a comparatively high swelling. Applications pertinent for their chemical resistance are paint brushes, surgical sutures and Zippers.

Cold-Molded Non-Refractory

Cold-molded materials of the non-refractory class are generally made of asbestos filler and a bituminous or a phenolic-resin binder. In general, the bituminous binder is resistant to acids and alkalis where the phenolic is not, and the phenolic is resistant to common organic solvents where the bituminous is not. The chemical resistance of these materials is usually adequate for the usual applications of cold-molded materials. If the application is unusual a further check should be made.

Moisture Absorption

Water is the most important single reagent to consider in the test for chemical resistance. It occurs most frequently and is also the medium of solution for many of the other reagents.

Moisture absorption is not a chemical reaction. Aside from remote instances, the possibility of water entering into chemical reaction with the plastic material can be dismissed. Likewise, there are only a few clear-cut cases in which water dissolves the plastic or one of its components. Polyvinyl alcohol is water soluble and the softer types of cellulose acetate have water-soluble constituents.

The principal effect of water is to diffuse through the material by capillary action. This action may carry with it a chemical reagent that attacks the plastic, leach out a soluble constituent, promote the growth of fungi, or cause swelling. Tests for 24-hr. or even 7-day immersions are long enough to indicate only a trend in moisture absorption. Most plastic materials do not reach their saturation equilibrium until after 18 to 24 months of immersion. Exposure to water vapor instead of immersion requires 10 to 50 percent longer to reach saturation. Since most plastics applications are not subject to such severe wetting, their true moisture absorption must be more or less estimated from the relative wetting and drying times in their service cycle. Long-time immersion tests show that various materials reach saturation at the following values:

Polystyrene	negligible
Vinyl Copolymer	0.2 percent
Methacrylate	1.5 percent
Ethyl Cellulose	4.5 percent
Urea	5.5 percent
Phenolic, general-purpose	7.0 percent
Casein	very high

Aging and Weathering

The most common types of action to which a plastic part is subject in service are:

1. Absorption of moisture and subsequent drying.
2. Effect of corrosive elements usually brought on by wetting of the surface of the part.
3. Oxidation of resin and filler which is continual and is accelerated by heat, moisture or sunlight.
4. Mechanical stress brought about by moisture absorption, freezing or thermal expansion.
5. Evaporation or leaching out of volatile or soluble constituents, such as plasticizers or lubricants.
6. Discoloration and fading from exposure to ultraviolet light and sunlight.

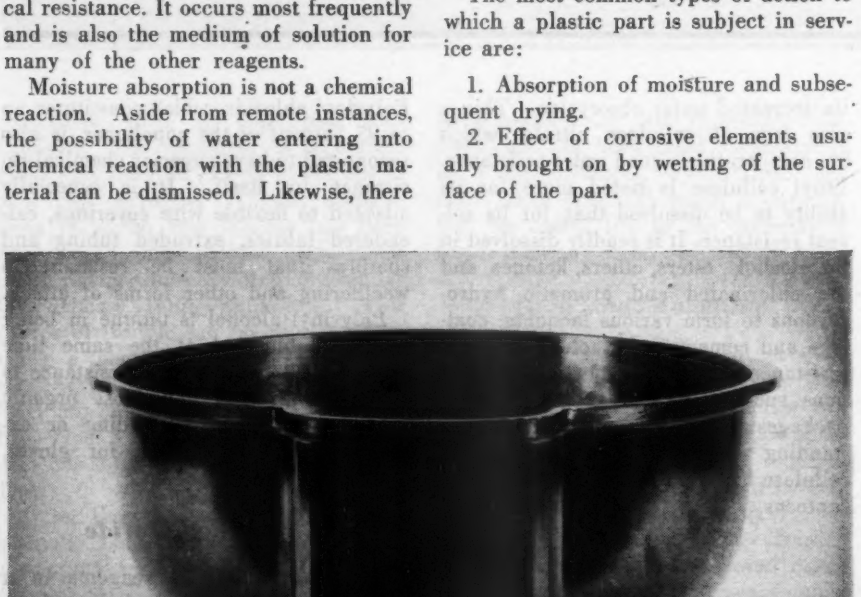
Phenolics in general withstand these types of deterioration very well. The most troublesome is usually warping and cracking brought about by uneven moisture absorption and uneven exposure to heat. The darker colors available in phenolics are not appreciably affected by weathering. Loss in appearance of parts generally results from swelling of surface fibers and loss of polish.

The design and manufacture of parts from ureas is more critical for satisfactory resistance to aging and weathering. Heavy sections are susceptible to cracking when wetted and dried. Sunlight tends to fade the lighter colors and the pastels, and severe ultraviolet will yellow the white urea resin. Thin well-cured sections retain their appearance and surface finish in outdoor applications.

Highly plasticized materials, such as cellulose acetate and some of the vinyl compounds, suffer in aging because of the loss of volatile plasticizers. The result is a gradual embrittlement of the plastic material. Samples of transparent cellulose acetate exposed for one year out-of-doors averaged a shrinkage of 2 percent and an increase in haze value of from 6 percent up to 15 percent.

Taste and Odor Characteristics

Many plastics will impart or have objectionable odors and tastes when used in contact with foods, beverages, drugs or cosmetics. Recognition and evaluation of this characteristic is frequently difficult. Odors can be accentuated by placing the plastic in a jar of hot water and sealing. After a short interval the odor should be distinguishable when the jar is opened. The effect on foods can sometimes be detected by the taste of sweet butter which has been in contact with the plastic for a short time. Phenolic closures are known to contaminate the odor and taste of alcoholic liquors. A bromination test developed to detect this tendency determines the amount of free phenol and ammonia in the phenolic. The chemical determination compares favorably with standard odor-taste tests. Very little quantitative data are available on this characteristic largely because of lack of a suitable test.



Cream separator bowl is molded of phenolic plastic to resist milk, cream and cleaning agents. The material does not impart taste or odor.

INDUSTRY AND SOCIETIES

NEWS • READER LETTERS • MEETINGS

Postwar Television Sets To Be Better Than Prewar Models

TELEVISION SERVICE, including low-cost home receivers far superior to prewar models, can be offered the public as soon after the war as materials and manufacturing facilities permit, according to Thomas F. Joyce, general manager of the radio, phonograph and television department, and C. B. Jolliffe, chief engineer of the RCA Victor Division, of the Radio Corporation of America, in statements at hearings urging the Federal Communication Commission to permit television to go ahead in its present channels.

Mr. Joyce appealed for adoption by the FCC of the frequency allocation proposals previously submitted to the hearing by the Television Panel of the Radio Technical Planning Board. He said that RCA was prepared to offer greatly improved postwar television home receivers ranging in price from about $150 for a table model to $395 for a large projection model incorporating standard and frequency modulation reception. These receivers, he indicated, will be superior from the standpoint of picture size, detail, brightness, contrast and simplicity of operation.

To make these receivers a reality, he declared, RCA will have to invest more than $10,000,000. However, neither RCA nor any other company would make the necessary investment unless there was assurance that the standards and frequency assignments for television are fixed, and are such as to assure rapid development of the art.

Television receivers, Mr. Joyce said, should be available and on the market nine to twelve months after civilian production is authorized. This, he continued, requires RCA as well as other manufacturers to make important basic decisions today regarding manufacturing facilities and product design, which involves considerable investment.

Mr. Jolliffe acted as spokesman for the more than 1,000 engineers that RCA has had working on the research, development, design and production of radio equipment for the armed forces during the war. These men have served on groups of NDRC and OSRD and have participated in conferences with civilian engineers and officers of the Army, Navy and Allied countries. Much of the work that these engineers have been doing, Mr. Jolliffe said, can contribute directly or indirectly to television developments and provides experience and tools useful in such development. With this experience and background RCA engineers have contributed to the work of the RTPB, he said.

Indicating that RCA engineers support the recommendations of Panel 6 of RTPB wholeheartedly. Mr. Jolliffe said that the standards and the place in the frequency spectrum recommended by RTPB for television are technically sound and that when war developments are released these recommendations will be found to be fully justified and based on good engineering judgment.

New Laboratory Expands Experiments on Induction

REPORTED to be the largest laboratory of its kind, the recently completed high-frequency induction experimental laboratory of the TOCCO Division of the Ohio Crankshaft Company covers 20,000 sq. ft. of floor space and is equipped with 24 test heating stations supplied by 2,000 kw. having a frequency range from 960 to 1,000,000 cycles. Experimental work can be done on applications for the hardening, brazing, annealing or heating for forming of large and small ferrous or non-ferrous parts. Built specially in a one-story, arched-roof, 51x380-ft. building, the laboratory has three divisions—experimental, engineering and sales. Three-quarters of the space is designated solely for engineering and shop experimentation.

Experimental induction machines are of varied styles and capacities, the most distinctive being an eight-station, panel-type unit of 9,600 cycles, 25 ft. long and 6 ft. high, and having automatic controls. Progressive hardening of bars and tubing is carried out on two machines, one hydraulically and the other mechanically controlled, operating on 9,600 cycles. They have facilities for obtaining maximum speed and power depending upon requirements of parts under test.

Tests on big parts such as crankshafts, steam-hammer rods and generator shafts are made on a 4-station unit, 20 ft. long, equipped with a moving cradle set on a track to hold test parts positioned in the water-cooled inductors. Each station is equipped with automatic and manual control devices. Power frequencies of 1,000, 2,000, 3,000 and 10,000 cycles provide induction flexibility.

Another special test unit, for gear hardening, is a 5x5x5-ft. fixture with automatic control devices and with the circular inductor, which can be changed to accommodate a new size, and quenching mechanism set in the center. Water or oil quenching is provided. A battery of five standard m.g. TOCCO machines of 9,600-cycle capacity is available for experiments involving specially designed fixtures or where production runs are being simulated. Plans call for immediate installation of a special 500-kw. hydrogen-cooled motor generator for work on massive parts having intricate surfaces, such as large gears.

Running beneath the floor in a covered trench is the quench and water-cooling system. At 10-ft. intervals in this trench are connections for compressed air, city water, hot water and natural gas.

Adjacent to the main laboratory is an experimental department for the development of new electronic equipment. Tube oscillator-type machines ranging from 2½ to 100 kva. for test purposes have an output capacity and frequency range from 100,000 to 1,000,000 cycles. Commercial experimental projects are conducted here for industrial users.

A metallurgical laboratory for check-

ing microstructure, hardness and related physical properties, and chemical analysis is operated in conjunction with the chemical laboratory where ferrous and non-ferrous materials are analyzed and tests are conducted relating to the hardenability of steels and the comparisons between induction and furnace treatment. Serving these departments is a photographic dark room.

A novel feature of the new laboratory is the 15x23-ft. lecture room equipped for slide projection and display purposes. It is available for engineering and sales talks to technical and customer groups.

Alkyl Phenols Simplify Synthetic Rubber Working

SOFTNESS and tackiness in butadiene-type synthetic rubber is achieved by the introduction of a class of materials known as alkyl phenols, according to a patent issued to Charles F. Fryling and assigned to the B. F. Goodrich Company. This means that synthetic rubber, especially the oil-resistant type, which lacks stickiness or tack in the unvulcanized state, can be calendered, extruded or laminated in plies with less difficulty during manufacture.

Unit to Heat Oil Necessary In Airplane Gas Turbine

Because little heat is transmitted to lubricating oil in the gas-turbine power plant of the jet-propelled airplane, a special heating system was perfected by the General Electric Company to keep the oil at the proper temperature. Thermostat control is provided to allow for varying low temperatures at high altitudes.

The reason this heating system is necessary, according to General Electric engineers, is that there is only one major moving part in the gas-turbine unit. Because it rotates without appreciable vibration it can be supported on anti-friction bearings.

Oil consumption is negligible, and the amount of lubricating oil required by the gas turbine is, therefore, small—15 percent or less of that required for other aircraft power plants. The entire lubricating system is part of the gas-turbine engine, and there are no complex cooling mechanisms, oil coolers, or large oil tanks involved.

Production and operation of the gas turbine are facilitated because of its simplicity, according to General Electric engineers. The power plant is a "packaged" unit which is easily installed. Inasmuch as it operates without appreciable vibration it can be tied to the airframe. From the standpoint of operation, relatively few gages and instruments face the pilot in the cockpit, and there are no propeller or fuel-mixture controls. The gas turbine engines will burn kerosene, automobile gasoline, or aviation high-test gasoline without any major changes being required. Since combustion is continuous, high-octane fuels are not needed, and cheaper fuels are preferred.

Freezing Expands Undersized Parts

UNDERSIZED articulated rod pins used in Pratt & Whitney 2,000-hp. aircraft engines built by Ford Motor Company are expanded 0.0002–0.0003 in. by cooling them to —313 deg. F. in liquid air. This "growth" takes place on the outer surface of the metal subjected to the cold treatment.

The process involves a change in the physical properties of austenite, a constituent present in varying quantities in most alloy steels. Under conditions of extreme heat or cold, austenite breaks down into martensite, an element of greater bulk, thus increasing the dimensions of the part.

Sixteen rod pins are used on each aircraft engine built by Ford, and slightly undersized pins formerly were discarded. An estimated 16,000 pins already have been salvaged by this freezing process. Experiments in expanding other parts have yielded promising results, and company engineers predict that the process ultimately will find widespread use.

Postwar Clippers Will Be Revolutionary

DETAILS of an advanced type of giant sub-stratosphere clipper ordered by Pan American World Airways from Douglas Aircraft Company were revealed recently. The contract calls for delivery of 26 four-engined clippers, designated as DC-7s, at $40,000,000 estimated cost.

Carrying 108 passengers and a crew of 13, and capable of more than 300 m.p.h. speed, these planes will have pressurized cabins for passenger comfort at 20,000 ft. Their wings will be longer, from tip to tip, than the height of a 16-story building and large enough to provide interior passage-ways for servicing and repairing engines in flight. The planes will be twice as large as Pan American's present clippers and seven times larger than the DC-3 transports now used by most airlines.

They will be powered by four Pratt & Whitney engines of greater displacement than the 2,100-hp. Double Wasps. Details of this new engine are still a military secret. The super-hydromatic Hamilton Standard propeller, a new design, also will be used.

Two cabins, one accommodating 72 passengers and the other 36, a galley equipped for serving full-course meals, dressing rooms, toilets, cargo compartment, flight deck and compartment for pilots will be provided. There will also be large storage compartments for food and electrically operated stoves and refrigerators will be included. Thermal de-icing systems will be built into the wings and other surfaces.

Activities Among Technical Societies

FELT GROUP ACTS ON PLANS FOR FUTURE

As a result of recent meetings and committee discussions, the Felt Association, Inc., has taken action that may have important effects on the use of this material. For one thing, the Standards Committee reports that the joint Army-Navy Aeronautical Specification AN-F-14 has been changed, particularly revising the minimum splitting resistance of item No. 3 to 22 lb. Changes in the specification have been suggested to the Society of Automotive Engineers. Meantime, the desirability of making certain S.A.E. felts in tolerances of weight and width is being discussed. Also, because of the growth of the sheet felt branch of the industry, a fact-finding program has been undertaken and to this end a sub-committee will work in conjunction with the Standardization Committee.

HOW A.S.M.E. CAN HELP MEMBERS IN ARMED FORCES IS ASKED BY GATES

Suggestions as to how the American Society of Mechanical Engineers can aid its members in the armed forces to make the shift from war to peace have been asked of members who are in military service by Robert M. Gates, president of the society, in a letter to 3,000

of these engineers. Mr. Gates states in his letter that the society is encouraging industrial management and educational institutions to cooperate in advanced postwar training and personnel replacement, and that he foresees a high degree of usefulness in the postwar world for those members now in military service. The letter appears in full in the November issue of *Mechanical Engineering*, the society's monthly publication.

AWARDS OF MEDALS AND HONORARY MEMBERSHIPS MADE BY A.S.M.E.

During ceremonies at the annual meeting of the American Society of Mechanical Engineers held November 27 to December 1 the following awards of honorary memberships in the society and medals were made:

Honorary membership—Charles M. Allen, professor of hydraulic engineering, Worcester Polytechnic Institute; Major-Gen. Levin H. Campbell, Jr., chief of ordnance of the United States Army; and Rear-Adm. Emory S. Land, U. S. N. (Retired), chairman, United States Maritime Commission.

A.S.M.E. Medal—Edward G. Budd, president of the Budd Manufacturing Company, "because of his outstanding engineering achievements" in connection with welded carbon- and alloy-steel structures and the forming of sheet metal by deep drawing.

Holley Medal—Carl L. Norden, of Carl L. Norden, Inc., "for the invention and development of the Norden bombsight and other valuable devices which should hasten the peace."

Worcester Reed Warner Medal—Earle Buckingham, professor of mechanical engineering, Massachusetts Institute of Technology, "for his original contributions to engineering literature, especially in the fields of interchangeable manufacturing and gearing, based no less on his extensive research work than on his broad experience in many fields of practical manufacturing."

Spirit of St. Louis Medal—George W. Lewis, director of aeronautical research, National Advisory Committee for Aeronautics, "for leadership in direction and encouragement of aeronautical research, having an extensive influence on aeronautical engineering during the past quarter century."

Charles T. Main Award—Fred M. Piaskowski, of the University of Detroit, for his paper "A Case Study of Labor-Management Co-Operation."

Undergraduate Student Award—Nelson B. Hammond, University of Pennsylvania, for his paper "An Investigation of Silver-Solder Penetration in Brass Joints."

Meetings

American Society of Refrigerating Engineers—40th annual meeting, Dec. 10-13, Hotel Pennsylvania, New York, N. Y.

Society of Automotive Engineers—Annual meeting, Jan. 8-12, 1945, Hotel Book-Cadillac, Detroit, Mich.

Institute of Aeronautical Sciences—13th annual meeting, Jan. 30-Feb. 1, 1945, New York, N. Y.

RECORD DEMAND PREDICTED FOR PACKAGING MACHINERY

Immediate replacement of present equipment will make up a large part of an anticipated record demand for packaging machinery after the war. This was predicted by George A. Mohlman, retiring president of the Machinery Division of the Packaging Institute, Inc., and president of the Packaging Machinery Company, at the recent annual meeting of the institute. When the backlog of those orders has been cleared, however, the demand for new packaging machinery is expected to continue in equal volume because of an anticipated trend toward pre-packaging of fresh produce, and postwar technical advancements that will create new products and new wrapping materials demanding changed machinery designs.

The packaging industry is already working on advanced models for postwar development, Mr. Mohlman said, and one of the expected new fields is in pre-packaging of fresh vegetables and meats in consumer sizes, ready for pickup and purchase by the customer. This will revolutionize the corner grocery store, Mr. Mohlman predicted, for "the designers of machines that wrap candy bars or cup cakes can also design machines for packaging fresh peas, cabbage, potatoes, radishes and meats in convenient sizes." Mr. Mohlman told the institute that the major problem confronting packaging machinery engineers is control of vapor tightness, but he said that experts are confident of overcoming this factor.

REFRIGERATION RESEARCH SPONSORED IN GRANTS

A program of research sponsored by the American Society of Refrigerating Engineers has been started by granting $500 to each of four institutions engaged in refrigeration education and research. The Universities of Illinois and Tennessee will receive similar amounts, already approved by the A.S.R.E. Council, as soon as final details of their projects are completed. The grants made so far on the basis of recommendations of the A.S.R.E. Committee on Education and Research are as follows:

Massachusetts Institute of Technology—Project: The investigation of various calorimeters used in refrigeration test work in order to propose a standard calorimetric procedure for testing of small- and moderate-sized refrigeration compressors.

Case School of Applied Science—Project: Pressure drop in freon evaporators.

Oregon State College—Project: To be known as Project No. 53, this research is a continuation and refinement of a project on which some work has already been done to determine values of film coefficient of heat transfer from metal surfaces to boiling ammonia in a flooded evaporator.

University of Texas—Project: Developing methods of preserving fish beginning with the time it is first caught.

CHEMICAL INDUSTRY MEDAL PRESENTED TO COL. DEWEY

Presentation of the Chemical Industry Medal of the American Section of the Society of Chemical Industry to Col. Bradley Dewey, president of Dewey & Almy Chemical Company and former rubber director, was made at a recent joint meeting with the New York Section of the American Chemical Society and the American Institute of Chemical Engineers. The election of Col. Dewey to receive the medal is in recognition of his work in colloid chemistry, especially as pertaining to rubber latex, and his accomplishments in administrating the synthetic rubber program during the critical war period.

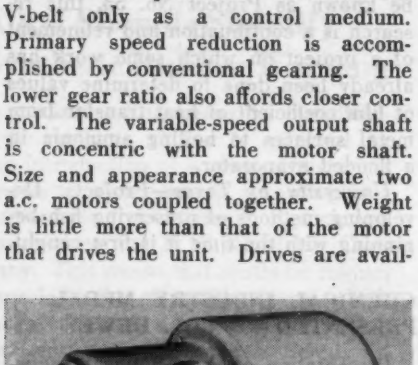
ERROR IN EDITING CHANGES TRAPEZOIDAL CANTILEVER BEAMS

In the chart, page 792, November, 1944, PRODUCT ENGINEERING, of the Reference Book Sheet "Trapezoidal Cantilever Beams of Constant Depth," the author, Victor Kibardin, has called attention to an error made by the editor in reproducing the original chart. The values of k for the curves on the left-hand side of the diagram are erroneously designated 0.1, 0.2, 0.3, 0.4, 0.5. They should read 0.0, 0.1, 0.2, 0.3, 0.4, respectively; that is, the line on the chart designated as 0.1 should be designated 0.0, the line designated as 0.2 should be designated 0.1, and so forth. The chart as reproduced designates two lines as 0.5, which is not true.

NEW MATERIALS AND PARTS

Variable-Speed Drive

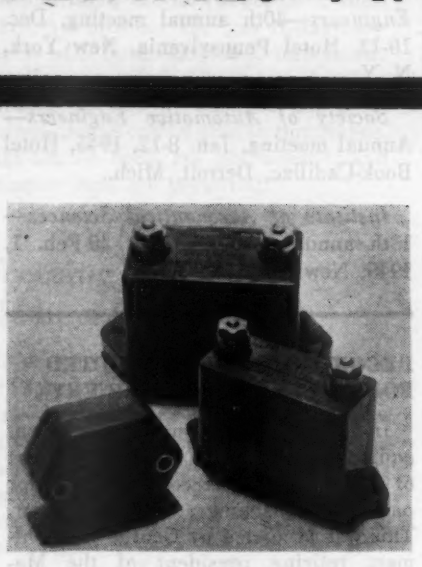
Inclosed gears that run in oil reduce noise and the possibility of dirt, grit and moisture getting into the gears in a variable-speed drive that uses the V-belt only as a control medium. Primary speed reduction is accomplished by conventional gearing. The lower gear ratio also affords closer control. The variable-speed output shaft is concentric with the motor shaft. Size and appearance approximate two a.c. motors coupled together. Weight is little more than that of the motor that drives the unit. Drives are avail-



able from 1 to 100 hp. and higher, with speed ratios ranging from 1.25:1 to 70:0. Remote control is available, with horizontally split casings optional. Lombard Governor Corp., Ashland, Mass.

Capacitors

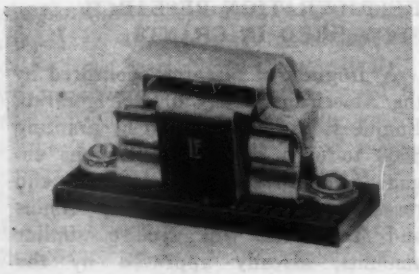
Available in case Types —60, —65, and —70, which are mechanically interchangeable with mica capacitors Types CM 60, 65 and 70 as listed in American War Standards Specification C75.3, Lectrofilm capacitors are made with a synthetic dielectric material developed especially for capacitors and which is characterized by uniform quality and stability under high ambient temperature conditions. These capacitors are suitable for radio-frequency blocking and by-pass applications in communications and other electronic equipment. The internal foil and Lectrofilm assemblies are arranged for minimum inductance and low foil losses. They are carefully treated to



assure a rigid assembly and permanence of characteristics under vibration, shock and wide temperature changes. The units are supplied in green low-loss plastic cases which guard the interior assembly against moisture. Complete nameplate data are permanently stamped into the case. General Electric Co., Schenectady, N. Y.

Small Circuit Breaker

Reset protection in the form of a circuit breaker, interchangeaable with all 5 A G or Navy "midget" size fuses, is the purpose of No. 1561 Breakerette. This is a push-breaker type, rated at 32 volts a.c. or d.c. Break is snap action capable of interrupting short circuits of 1,000 amp. in ratings up to 5-amp. and 2,500 amp. in ratings over 5-amp. capacity. Time characteristics of the fuses are duplicated electrically. The breaker is provided with 5 A G caps to fit standard 5 A G fuse clips. When the bi-metal releases the push-button on which it acts directly, a double break of the circuit is effected. The breaking distance is $\frac{1}{8}$ in. To reset, the button is pushed into its bottom position. Both trip-free and non-



trip free features are provided. Case is molded of phenolic plastic. A clear plastic shield gives visual indication when the breaker is tripped. Over-all dimensions are $1\frac{7}{8}$ x $\frac{3}{4}$ x $1\frac{1}{4}$ in. Maximum weight is 18 grams. The unit fits into clips on $\frac{7}{8}$ in. or greater spacing. Littelfuse, Inc., 4757 Ravenswood Ave., Chicago 40, Ill.

Automatic Selector

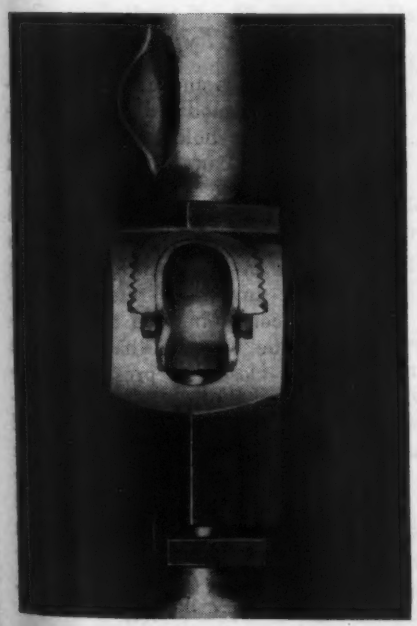
Smaller and lighter electrical equipment is made possible by Type FTR 800 automatic selector that is adaptable for use as an automatic or remote control device for railroad, radio, airport and industrial applications. This unit will make connection between a number of given circuits and a similar

number of other circuits, each preselected from a group; control and perform various operations among a group of circuits by making consecutive individual connections; or act as a timing device or switch when it is used in connection with time-pulsing apparatus. It can also be used in telegraph or electronic equipment, remote control and signaling systems, testing and radio control. The rotor assembly is operated by a stepping mechanism which responds to impulses of current. After each impulse, a reed-suspended pawl engages a ratchet, moving the wipers one step forward over the bank contacts. By this method connections are made from circuits connected to the

wipers to other circuits connected to the bank assembly. The stepping mechanism can be controlled manually or automatically by interrupter springs, electronic circuits or relay circuits. Wipers on the rotor can be either double-ended or single-ended, bridging or non-bridging. When required, the selector can be arranged so that the rotor will return automatically to normal position. It has been designed for an operating life of 4,000,000 revolutions. Dimensions are 2½ x 3¼ x 3½ in. Federal Telephone & Radio Corp., 28 Halsey St., Newark 1, N. J.

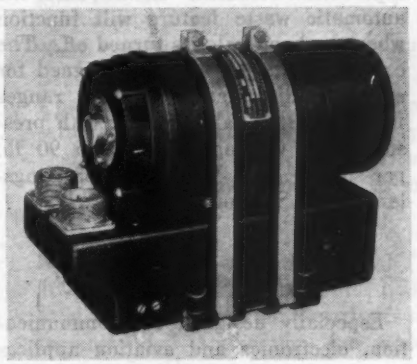
Tube Connection

Tube flaring operation is eliminated with a hydraulic tube connection that features greater resistance to vibration breakage and simpler installation procedures. Designed to meet specific needs of the aircraft industry but adaptable to the needs of other industries, the fitting provides a tight joint and can be used with both low and high pressure. Basic parts consist of the fitting, gland nut, small metal collar and synthetic rubber sealing ring. The fitting is installed by placing the gland nut, metal collar and rubber ring over the end of the tube and inserting the tube in the gland. When the gland nut is turned, force is exerted on the rubber ring with the metal serving to keep the nut from tearing the ring. Since the sealing ring is confined the axial thrust developed grips the tube and beads it. At the same time, the rubber is forced into every crevice to form a seal and exerts an outward force on the gland nut, locking the threads. After the proper bead has been made the gland nut bottoms in the fitting so that the tube cannot be crushed further. Tests have demonstrated that on ⅝-in. dia., 0.049-in. wall aluminum-alloy tubing, pressures as high as 5,000 lb. per sq. in. have been successfully withstood, while on ⅜-in. by 0.035-in. tubing the pressures have run up to 6,200 lb. per sq. in. In both instances the tube failed rather than the fitting. Glenn L. Martin Co., Baltimore 3, Md.



Motor Generator

Designed to operate from the aircraft d.c. electrical system, Type 800 motor-generators provide 800-cycle constant-frequency a.c., independent of engine-driven generators, for radio equipment and other accessories. Operation of the motor generator is automatic when the remote-control switch is closed. An integral carbon-pile voltage regulator maintains a constant a.c. supply of 115 volts over the rated operating range of the motor generator. With 28 volts d.c. and 75 amp. motor input, the generator at 0.9 power factor delivers 10.5 amp., 115 volts, 800 cycles, single-phase a.c. Output is based on using a 17-mfd. condenser in series with the resistance load. The unit is essentially a d.c. motor and alternator with rotors on a common shaft. A rotating field inductor and stationary windings eliminate the use of collector brushes. An integral control box houses a carbon-pile voltage regulator, solenoid starting switch, selenium rectifier and variable resistors. Dimensions are 11 13/16 x 8 19/32 x 5½ in. and weight is 24.5 lb. Eclipse-Pioneer Div., Bendix Aviation Corp., Teterboro, N. J.



Black Light Units

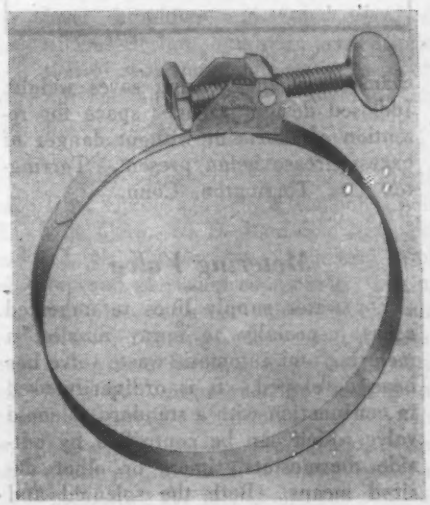
Available in both standard and custom-engineered models, to meet the varied requirements of different applications, Raymaster black light units are of the mercury-arc type. These devices are used for medical diagnosis, criminology, espionage, industrial inspection, mineralogy, theatre illumination, display advertising, soil and food analysis, laundry sorting, identification of counterfeits, chemical analysis, and illumination. Geo. W. Gates & Co., Hempstead Turnpike and Lucille Ave., Franklin Square, L. I., N. Y.

Testing Welded Seams

Welded seams of pressure vessels can be tested with Kano Kroil, a penetrating chemical with exceptionally low surface tension so that it spreads and creeps rapidly. The liquid penetrates through the metal to the opposite side if the seam is not tight. Laboratory tests have shown that the chemical penetrates a 0.000001-in. opening. Kano Laboratories, 75 E. Wacker Dr., Chicago 1, Ill.

Hose Clamp

Made of stainless steel, Series 820 flexible-band hose clamp meets requirements of Specification AN-FF-C-406a. Features include a nut that rocks on swivel pins and tips down when the thumb screw is tightened. This cinches the band, prevents slipping and gives high back-off torque. The flexible



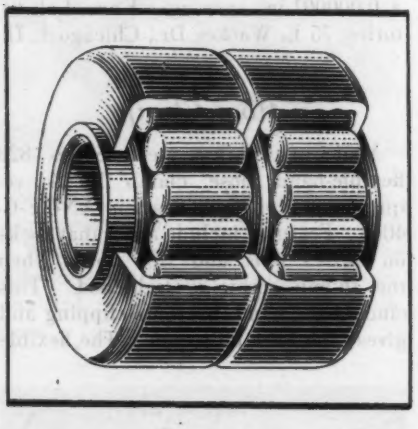
band conforms to the shape of any surface and does not pinch, regardless of screw pressure. The clamp is vibration-resistant. Three standard sizes are available for AN748 sizes 22 to 114, inclusive. Series 820-12 fits hose 11/16 to 1 5/16 O.D.; Series 820-14 fits hose 1 5/16 to 2 1/16 O.D.; and Series 820-16 fits hose 2 1/16 to 3 1/16 O.D. Marman Products Co., 940 W. Redondo Blvd., Inglewood Calif.

Synthetic-Rubber Cement

For mounting papers, drawings, photographs or tissues, a synthetic-rubber cement is offered. It is transparent and is said not to smear ink or curl or wrinkle papers. Excess can be removed with the fingers. The cement is available in various sized containers from desk bottles to gallon cans. Craftint Mfg. Co., 210 St. Clair Ave., N. W., Cleveland, Ohio.

Double-Row Needle Bearing

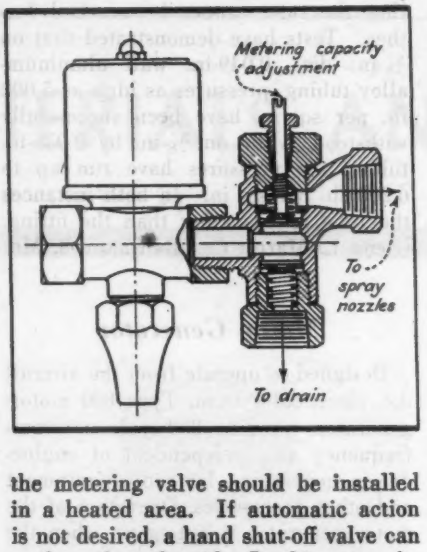
Specially designed to minimize friction in aircraft pulley applications, a double row PN needle bearing conforms to all requirements of Specification AN-FF-P-796. Small-diameter needle rollers provide capacity to meet standard government and aircraft company requirements, and the small outside



diameter of the bearing saves weight. Inclosed design provides space for retention of lubricant without danger of excess grease being present. Torrington Co., Torrington, Conn.

Metering Valve

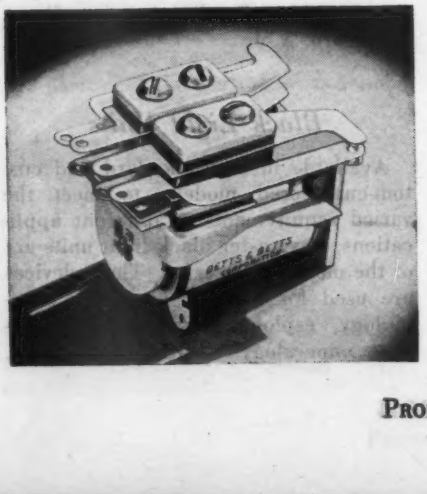
For water supply lines to unheated areas, especially to spray nozzles, a metering and automatic waste valve has been developed. It is ordinarily used in conjunction with a standard solenoid valve which can be controlled by outside thermostats, timers or other desired means. Both the solenoid and



the metering valve should be installed in a heated area. If automatic action is not desired, a hand shut-off valve can replace the solenoid. In this case, the automatic waste feature will function when the hand valve is turned off. The capacity metering stem is designed for external adjustment. Capacity ranges from 5 to 10.5 gal. per min. with pressure drop varying from 20 to 90 lb. per sq. in. Alco Valve Co., 865 Kingsland Ave., St. Louis 5, Mo.

Telephone-Type Relay

Especially designed for communication, electronics and aviation applications, Type RAC midget relays meet Army Air Force tests for altitude, vibration, shock, humidity and extreme temperatures. Coils are protected against moisture, corrosion and electrolytic action and have voltage range from 1½ to 70 volts d.c. A magnetic circuit permits operation with voltage fluctuation of ±25 percent. Insulation is inorganic-base plastic for minimum high-frequency loss and maximum strength. Each unit is subjected to a 1,000-volt breakdown test. Any arrangement of contacts up to 12 can be supplied for making, breaking or both. Contact springs are of resilient alloy with overall welded silver contact surfaces. Back pressure assures positive wiping action. Contact capacity is 2 amp. at 100 watts. Measurements of relays are 1 7/16 x 1 x 1 1/16 in., including first two pairs of contacts. Each additional two pairs of contacts add ⅛ in. to height. Weight is 1¾ oz. Betts & Betts Corp., 551 W. 52nd St., New York 19, N. Y.



Electric Actuators

First unit in a line of electric actuators, Geneva-Loc positioning actuator offers accurate control within 10 deg. of any series of operations up to eight positions with each position positively locked against movement. The unit incorporates a Geneva movement operated by a high-speed motor. Output shaft automatically locks at all stops and is independent of motor over-travel and temperature variations. No clutches, torque limiters, brakes or adjustable limit switches are used. The motor

comes up to speed under no load, then engages a cam with varying ratio which develops maximum torque at breakaway positions. Two to eight positions are provided. Pacific Div., Bendix Aviation Corp., 11600 Sherman Way, North Hollywood, Calif.

Marking Type Holder

Four type sizes and up to 20 characters are accommodated by an interchangeable type holder with which an entire number can be stamped on a part at one time. The holder is so constructed that type cannot be placed in it upside down, and all type is rigidly held in alignment. It consists of a body, anvil and release button. The anvil, containing the type, is connected to the body so that it can be opened and closed by pressing the release button. Pulling back on the release button slides the anvil back and locks the type in place. All holder parts are of machined steel. The holder is available with hand-cut hardened and ground steel type and with shank to fit hand, arbor or kick presses. Mercury Metal Die & Letter Co., 546 E. 16th St., Los Angeles 15, Calif.

Manufacturers' Publications

Graphic Illustration—Jordanoff Aviation Corp., 595 Madison Ave., New York 22, N. Y. Brochure, 32 pages and supplement. Describes the production of visual manuals, technical orders and Trans-Vision acetate overlays, with numerous examples of various techniques and how these tools can be used effectively.

Rivets—E. I. du Pont de Nemours & Co., Wilmington, Del. Bulletin A-4562, 12 pages. Gives details on explosive rivets, types and sizes, applications and installation procedure.

Pneumatic Control—Bellows Co., 861 E. Tallmadge Ave., Akron, Ohio. Photograph File. Consists of 25 8x10-in. photographs of representative installations of air motors and devices for industrial applications.

Standards—American Standards Association, 70 E. 45th St., New York 17, N. Y. Index, 24 pages. Lists all standards, safety standards and war standards of the association and gives price of each.

Electron Tubes—Special Products Div., Sylvania Electric Products Co., 60 Boston St., Salem, Mass. Bulletin 202, 24 pages. Nine types of special electron tubes and their applications are described, including technical data.

Screw Machine Products — Eastern Screw Machine Corp., New Haven, Conn. Bulletin No. 62, 24 pages. Data necessary for the proper design of screw machine products are given for use in the development of postwar products.

Rubber—Industrial Products Div. B. F. Goodrich Co., Akron, Ohio. Information Bulletin No. 8000, 2 pages. Compares properties of natural and various synthetic rubbers.

Threaded Fasteners—Industrial Screw & Supply Co., 711 W. Lake St., Chicago 6, Ill. Catalog No. 44, 108 pages. Gives sizes and materials used for screws, nuts, washers, bolts, rivets, pins and terminals.

Aluminum—Reynolds Metals Co., 2500 S. Third St., Louisville, Ky. Bulletin 35A and general bulletin, 8 and 4 pages, respectively. Former covers composition, physical properties, sizes, design standards and dimensional tolerances of typical extruded aluminum shapes; latter gives properties and applications of wrought aluminum alloys for various purposes.

D. C. Solenoids—Cannon Electric Development Co., 3209 Humboldt St., Los Angeles 31, Calif. Bulletin, 32 pages. Contains illustrations, tabular data, dimensional drawings, wiring diagrams and response characteristics charts regarding the company's line of d. c. solenoids.

Small Bearings—Miniature Precision Bearings, Keene, N. H. Bulletin No. 44, 4 pages. Dimensions, specifications, load ratings and applications for radial-type bearings from 1/8 to 7/8 in. O. D. and pivot-type bearings from 2 to 10 mm. O. D. are covered.

Bearing Metals—Magnolia Metal Co., 18 W. Jersey St., Elizabeth 4, N. J. Bulletin, 8 pages. Gives characteristics and recommended application for various bearing metals.

Clamps and Fittings—Punch-Lok Co., 321 N. Justine St. ,Chicago 7, Ill. Catalog P-1, 8 pages. Features clamps and fittings and gives sizes available.

Spring Fastener — Camloc Fastener Corp., 420 Lexington Ave., New York 17, N. Y. Catalog 44A, 8 pages. Describes and gives specifications and details of Series 4002 spring-loaded stud cowl fasteners.

Color—Eagle Printing Ink Co., 100 Sixth Ave., New York 13, N. Y. Three pamphlets. One is a summary of results of a survey of consumer demands for color; second is a check list of color standards and color systems used in American industry and science; third is an annotated bibliography of color.

Hydraulic Cylinders—John S. Barnes Corp., 301 S. Water St., Rockford, Ill. Bulletin 401-C, 4 pages. Gives features of hydraulic cylinders for machine-tool and other industrial applications.

Thermocouples—Wheelco Instruments Co., Harrison and Peoria Sts., Chicago 7, Ill. Booklet, S2-5, 40 pages. Data pertaining to selection of thermocouples, lead wire, protecting tubes, heads and insulators are given.

Polystyrene—Chemaco Corp., Berkeley Heights, N. J. Bulletin, 4 pages. Gives properties, suggested applications and typical uses for polystyrene now sold by the company.

Plastic Coatings — Amercoat Div., American Pipe & Construction Co., P. O. Box 3428, Terminal Annex, Los Angeles 54, Calif. Catalog, 16 pages. Describes and illustrates equipment and structures to which Amercoat plastic coatings have been applied.

Speed Reducer—Cleveland Worm & Gear Co., 3293 E. 80th St., Cleveland 4, Ohio. Bulletin, 4 pages. Presents details of the Speedaire fan-cooled worm-gear reducer.

Steel—LaSalle Steel Co., P. O. Box 6800-A, Chicago 80, Ill. Bulletin No. 4, 20 pages. Planned primarily as a guide for the selection of cold-finished and furnace-treated bar steels.

Relays—Eagle Signal Machine Co., Moline, Ill., Bulletin 291, 12 pages. Presents details, including uses and applications, of company's timers and relays.

Welding—Arcos Corp., 401 N. Broad St., Philadelphia 8, Pa. Chart. Gives composition, heat-treatment specifications and identification information of company's alloy-steel welding electrodes.

Sheet and Strip—Dayton Rogers Mfg. Co., Minneapolis 7, Minn. Slide Calculator. Weight of sheet or strip metal 1/8 to 96 in. wide, 0.002 to 1 in. thick and 1/4 in. to 1,000 ft. long can be obtained.

Controls—Bristol Co., Waterbury 91, Conn. Bulletin A115, 8 pages, and P1202, 12 pages. Former gives details of Model 93 air-operated controllers for temperature, pressure, vacuum, liquid level, humidity and flow; latter describes design, operation and application of radiation pyrometers for recording and automatically controlling temperatures above 900 deg. F.

Plastics—Bakelite Corp. and Plastics Div., Union Carbide & Carbon Chemicals Corp., 30 E. 42nd St., New York 17, N. Y. Booklet, 24 pages. Molding and extrusion compounds; laminating plastics; sheets, sheeting and film; rods and tubing; cast resins; glues and adhesives; bonding materials; coating products; impregnating, sealing and calendering materials; and special copolymer resins are described and their applications, characteristics and properties are included.

Standard Holes for Pins and Bolts, And Cylindrical Fits

A. H. PETERSEN

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The value and advantages of these tables are discussed in the articles on page 813.

Standard Holes for Pins and Bolts

To facilitate assembly use as loose a fit as permissible. See page 857 for application of hole sizes. These hole sizes do not apply to sheet metal structures that are to be dimpled or countersunk.

Size	Clevis Pin and Clevis Bolt Diameter	AN Bolt or Screw Diameter	Drill Size				Bolt	Bolt Dia.	Ream
			Extra Loose Drilled	Loose Drilled	Clearance Drilled	Close Drilled			
No. 4		0.112	No. 27 (0.144)	No. 30 (0.128)					
1/8	0.124 0.122				No. 30 (0.128)	1/8 (0.125)			
No. 6		0.138	No. 13 (0.185)	No. 18 (0.170)					
No. 8		0.164	7/32 (0.219)	No. 10 (0.194)	No. 18 (0,170)				
3/16	0.186 0.184			No. 2 (0.221)	No. 11 (0.191)	No. 12 (0.189)			0.1883 0.1873
No. 10		0.189 0.1865	1/4 (0.250)	No. 2 (0.221)	No. 10 (0.194)	No. 11 (0.191)	NAS53	0.1894 0.1889	0.1908 0.1898
1/4	0.248 0.246	0.249 0.246	21/64 (0.328)	9/32 (0.281)	F (0.257)	1/4 (0.250)	NAS54	0.2492 0.2487	0.2508 0.2498
5/16	0.311 0.309	0.3115 0.3085	25/64 (0.391)	11/32 (0.344)	0 (0.316)	5/16 (0.312)	NAS55	0.3117 0.3112	0.3134 0.3123
3/8	0.373 0.371	0.374 0.371	7/16 (0.438)	13/32 (0.406)	V (0.377)	3/8 (0.375)	NAS56	0.3742 0.3737	0.3759 0.3748
7/16	0.436 0.434	0.4365 0.4330	33/64 (0.516)	15/32 (0.469)		7/16 (0.4375)	NAS57	0.4367 0.4362	0.4384 0.4373
1/2	0.497 0.495	0.4990 0.4955	19/32 (0.594)	17/32 (0.531)		1/2 (0.500)	NAS58	0.4991 0.4986	0.5009 0.4998
9/16	0.560 0.558	0.5615 0.5575				9/16 (0.562)	NAS59	0.5616 0.5611	0.5635 0.5623
5/8	0.622 0.620	0.624 0.620				5/8 (0.625)	NAS60	0.6240 0.6234	0.6260 0.6248
3/4	0.747 0.745	0.7490 0.7445				3/4 (0.750)	NAS62	0.7488 0.7481	0.7510 0.7498
7/8	0.871 0.869	0.874 0.869				7/8 (0.875)	NAS64	0.8737 0.8729	0.8762 0.8748
1	0.996 0.994	0.9990 0.9935				1 (1.000)	NAS66	0.9985 0.9975	1.0012 0.9998

Application of Standard Hole Sizes

Type of Fit		Load on Bolt	Application
Bolt	Hole		
Use with AN bolts (or equivalent)	Slotted Extra Loose Drilled Loose Drilled (Approx. 0.03 Clearance)	Shear or Shear and Tension Combined	Used in attachments with high margins of safety to give interchangeability without expensive tooling. Examples of this application are attachment of light equipment such as junction boxes, fairleads, clampblocks, brackets and non-stressed accessories, Not to be used in the sheet to which non-floating plate nuts are attached, but should be used in the mating part if possible. Used in attachments where floating nuts are required. Slotted holes must be used where loose and extra loose drilled holes give insufficient adjustment. More expensive to produce than a round hole. Loose and extra loose drilled holes must be used in wood for nonstructural applications.
		Tension	Used for sheet metal screws with sheet metal nuts. Used when the required alignment does not require a closer fit.
	Clearance Drilled	Shear or Shear and Tension Combined	Used in the majority of structural connections that are inherently overstrength in bearing (M.S. greater than 0.50) and are not subjected to shock, vibration, or frequent reversal of load. Relative movement between parts before bolts are tightened is very slight, especially where several bolts are used in the joint.
		Tension	Used only when a loose drilled hole will not give proper alignment.
	Close Drilled	Shear or Shear and Tension Combined	Used in structural connections that are designed to relatively low margins of safety. (M.S. less than 0.50). When four or more bolts are employed, this fit is satisfactory where loads are applied with shock or vibration, or where frequent reversal of load occurs. When less than four bolts are used in the joint, applications should be restricted to joints not subject to shock or vibration or frequent reversal of load.
		Tension	Used only when alignment of parts requires a fit of this type.
Use with NAS close tolerance bolts only	* Reamed	Shear or Shear and Tension Combined	Used only with ground close tolerance NAS bolts. Used in connections employing less than four bolts where the loads are applied with shock, vibration, or frequent reversal of load. High production cost.

* Designs employing reamed holes, other than in replaceable bushing applications, should allow sufficient material to permit reaming and to give a clearance for 1/16 in. larger bolts or screws in service. Drawings must state permissible diameter increases.

Note: To facilitate assembly, use as loose a fit as permissible.

Standard Holes for Pins and Bolts, And Cylindrical Fits (continued)

Cylindrical Fits

Dia. Range	Std. Hole Sizes (in Steps of)	Running Fit—Free (Medium Clearance)			Running Fit—Medium (Low Clearance)			Snug or Push Fit (Imperceptible Clearance)			Press Fit—Medium Force (Medium Interference)		
		Tolerance		Clearance Max. Min.	Tolerance		Clearance Max. Min.	Tolerance		Clearance Max. Min.	Tolerance		Interference Max. Min.
		Hole	Shaft		Hole	Shaft		Hole	Shaft		Hole	Shaft	
0.000	1/32	+.0008	−.0006	0.0022	+.0006	−.0004	0.0016	+.000	−.0003	0.0013	+.0006	+.0012	0.0014
0.250		−.0002	−.0014	0.0004	−.0002	−.0010	0.0002	−.0002	−.0007	0.0001	−.0002	+.0008	0.0002
0.251	1/32	+.0009	−.0009	0.0028	+.0006	−.0006	0.0020	+.0006	−.0003	0.0014	+.0006	+.0014	0.0016
0.500		−.0002	−.0019	0.0007	−.0002	−.0014	0.0004	−.0002	−.0008	0.0001	−.0002	+.0009	0.0003
0.501	1/16	+.0010	−.0012	0.0034	+.0007	−.0008	0.0024	+.0007	−.0004	0.0017	+.0007	+.0016	0.0018
0.750		−.0002	−.0024	0.0010	−.0002	−.0017	0.0006	−.0002	−.0010	0.0002	−.0002	+.0010	0.0003
0.751	1/16	+.0012	−.0014	0.0040	+.0007	−.0010	0.0027	+.0007	−.0004	0.0018	+.0007	+.0018	0.0020
1.000		−.0002	−.0028	0.0012	−.0002	−.0020	0.0008	−.0002	−.0011	0.0002	−.0002	+.0011	0.0004
1.001	1/8	+.0015	−.0017	0.0049	+.0008	−.0012	0.0031	+.0008	−.0004	0.0020	+.0008	+.0021	0.0023
1.500		−.0002	−.0034	0.0015	−.0002	−.0023	0.0010	−.0002	−.0012	0.0002	−.0002	+.0013	0.0005
1.501	1/8	+.0017	−.0021	0.0057	+.0008	−.0015	0.0035	+.0008	−.0004	0.0021	+.0008	+.0023	0.0025
2.000		−.0002	−.0040	0.0019	−.0002	−.0027	0.0013	−.0002	−.0013	0.0002	−.0002	+.0014	0.0006
2.001	1/4	+.0021	−.0022	0.0064	+.0011	−.0015	0.0039	+.0011	−.0002	0.0023	+.0011	+.0028	0.0028
2.500		−.0000	−.0043	0.0022	−.0000	−.0028	0.0015	−.0000	−.0012	0.0002	−.0000	+.0018	0.0007
2.501	1/4	+.0022	−.0025	0.0069	+.0011	−.0017	0.0042	+.0011	−.0002	0.0024	+.0011	+.0031	0.0031
3.000		−.0000	−.0047	0.0025	−.0000	−.0031	0.0017	−.0000	−.0013	0.0002	−.0000	+.0020	0.0009
3.001	1/4	+.0024	−.0030	0.0078	+.0012	−.0020	0.0048	+.0012	−.0002	0.0026	+.0012	+.0035	0.0035
4.000		−.0000	−.0054	0.0030	−.0000	−.0036	0.0020	−.0000	−.0014	0.0002	−.0000	+.0023	0.0011
4.001	1/4	+.0026	−.0035	0.0087	+.0013	−.0023	0.0053	+.0013	−.0002	0.0028	+.0013	+.0039	0.0039
5.000		−.0000	−.0061	0.0035	−.0000	−.0040	0.0023	−.0000	−.0015	0.0002	−.0000	+.0026	0.0013
5.001	1/4	+.0028	−.0040	0.0096	+.0014	−.0026	0.0058	+.0014	−.0002	0.0030	+.0014	+.0044	0.0044
6.000		−.0000	−.0068	0.0040	−.0000	−.0044	0.0026	−.0000	−.0016	0.0002	−.0000	+.0030	0.0016
6.001	1/4	+.0029	−.0044	0.0102	+.0015	−.0029	0.0063	+.0015	−.0002	0.0032	+.0015	+.0049	0.0049
7.000		−.0000	−.0073	0.0044	−.0000	−.0048	0.0029	−.0000	−.0017	0.0002	−.0000	+.0034	0.0019
7.001	1/4	+.0030	−.0048	0.0108	+.0015	−.0032	0.0067	+.0015	−.0002	0.0033	+.0015	+.0053	0.0053
8.000		−.0000	−.0078	0.0048	−.0000	−.0052	0.0032	−.0000	−.0018	0.0002	−.0000	+.0037	0.0022
		Running fits with speeds of 600 r.p.m. or over and journal pressures of 600 lb. per sq. in. or over. Should be used wherever possible, especially for average fits. Used for hydraulic cylinders, pistons and rods. Wobble or shake between mating parts very slight. Parts will turn and slide freely. Shafts can be turned or ground. Holes reamed, bored, or broached.			Running fits under 600 r.p.m. and journal pressures under 600 lb. per sq. in. Also for sliding fits. Shake or wobble between mating parts noticed only on parts with short bearing length. Shafts can be ground or precision turned. Holes reamed, bored or broached.			Closest fit that can be assembled by hand and necessitates work of considerable precision. Should be used where no perceptible shake is permissible and where moving parts are not intended to move freely under a load. Shafts can be ground. Holes reamed, bored, or broached.			Considerable pressure is required to assemble these fits and the parts are considered more or less permanently assembled. Bushings and similar uses. Shafts can be ground. Holes reamed, bored, or broached.		

Example: A free running fit is desired with a basic size of 2 in. dia.
Tolerances obtained from the table are: Hole +.0017, Shaft +.0021
−.0002 −.0040
Therefore, drawing dimensions will be: Hole +2.0017, Shaft +1.9979
−1.9998 −1.9960

Note: When a special fit is required, hole tolerances should be identical to one of above fits, and only shaft tolerances should be varied to obtain the required condition.

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This index covering the 12 monthly numbers of PRODUCT ENGINEERING for 1944 is presented in three sections:

1. An alphabetical index arranged according to the chief subject matter and cross-indexed to facilitate locating the item sought.

2. A classified index with articles and special sections appearing under 16 appropriate headings.

3. An authors' index listing the names of the writers and the subjects they have presented in the 12-month period.

Page references to editorials and to the special 16-page sections on materials and processes for present and postwar uses are listed in separate boxes.

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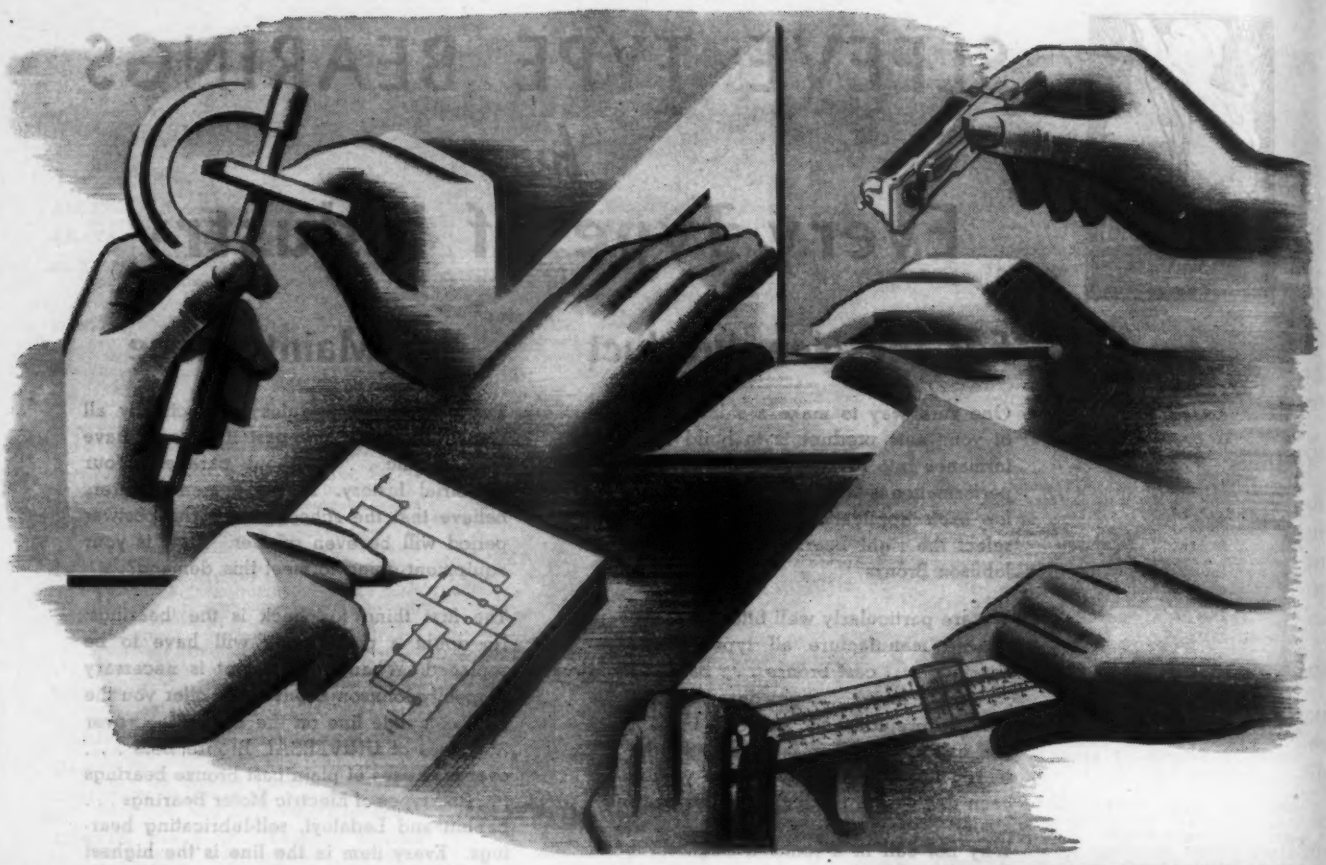

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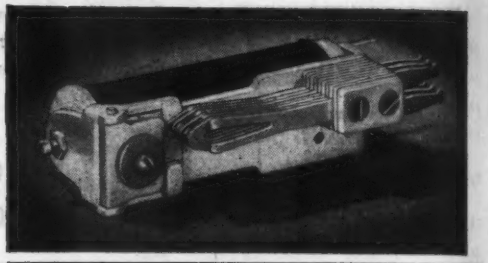

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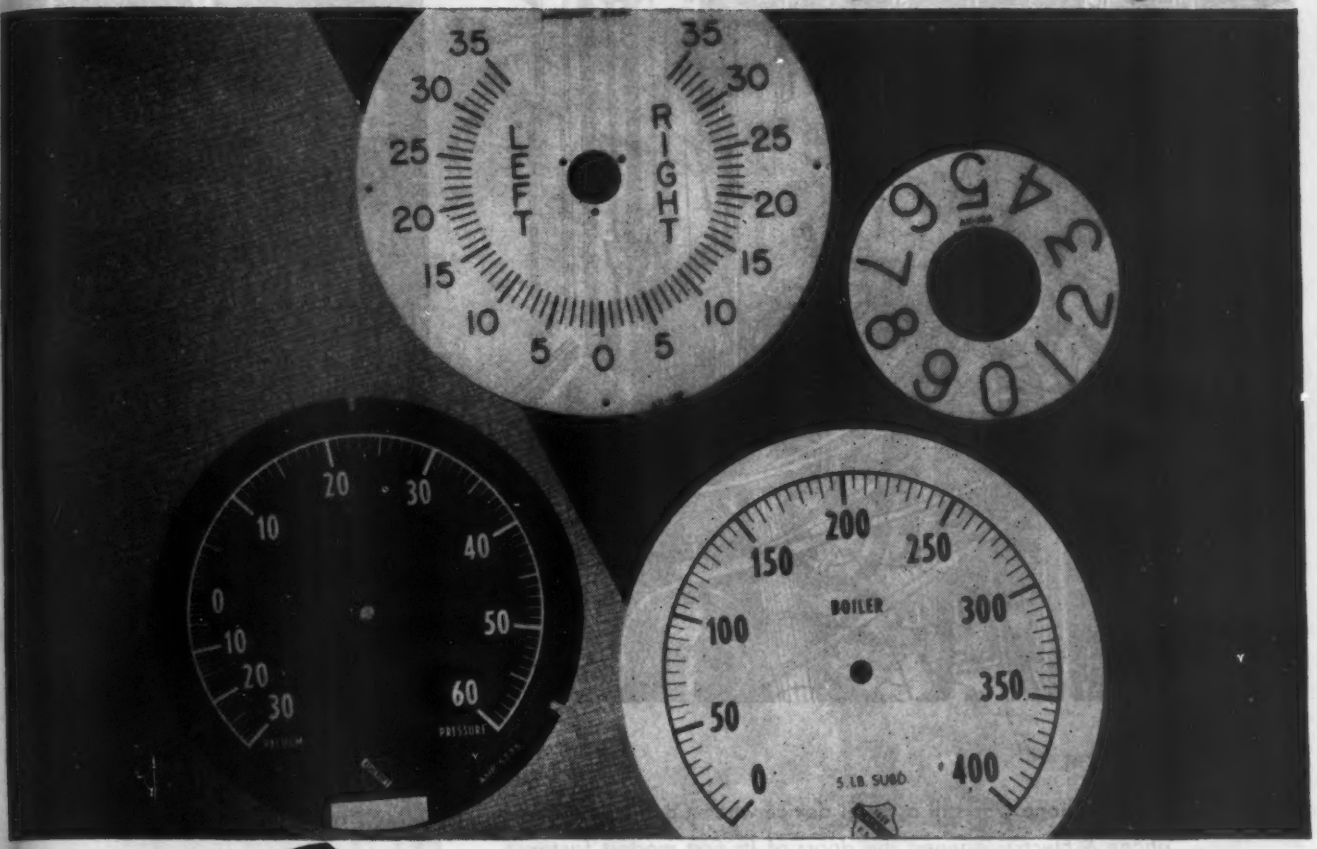

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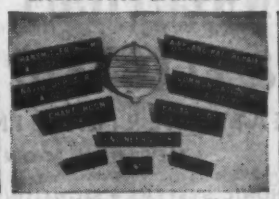

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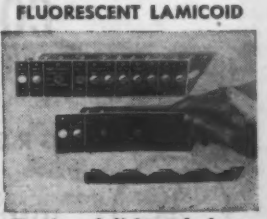

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BACKGROUND FOR KNOW-HOW

The telephone was still a novel device when *Connecticut Telephone & Electric* opened the doors of its first modest factory. Ever since, its people seem to have formed the habit of contributing to each revolutionary step ahead in communications.

For example, they helped to take the electronic tube out of the laboratory, and put it to work for everybody, by producing one of the first such tubes to be manufactured on a commercial scale.

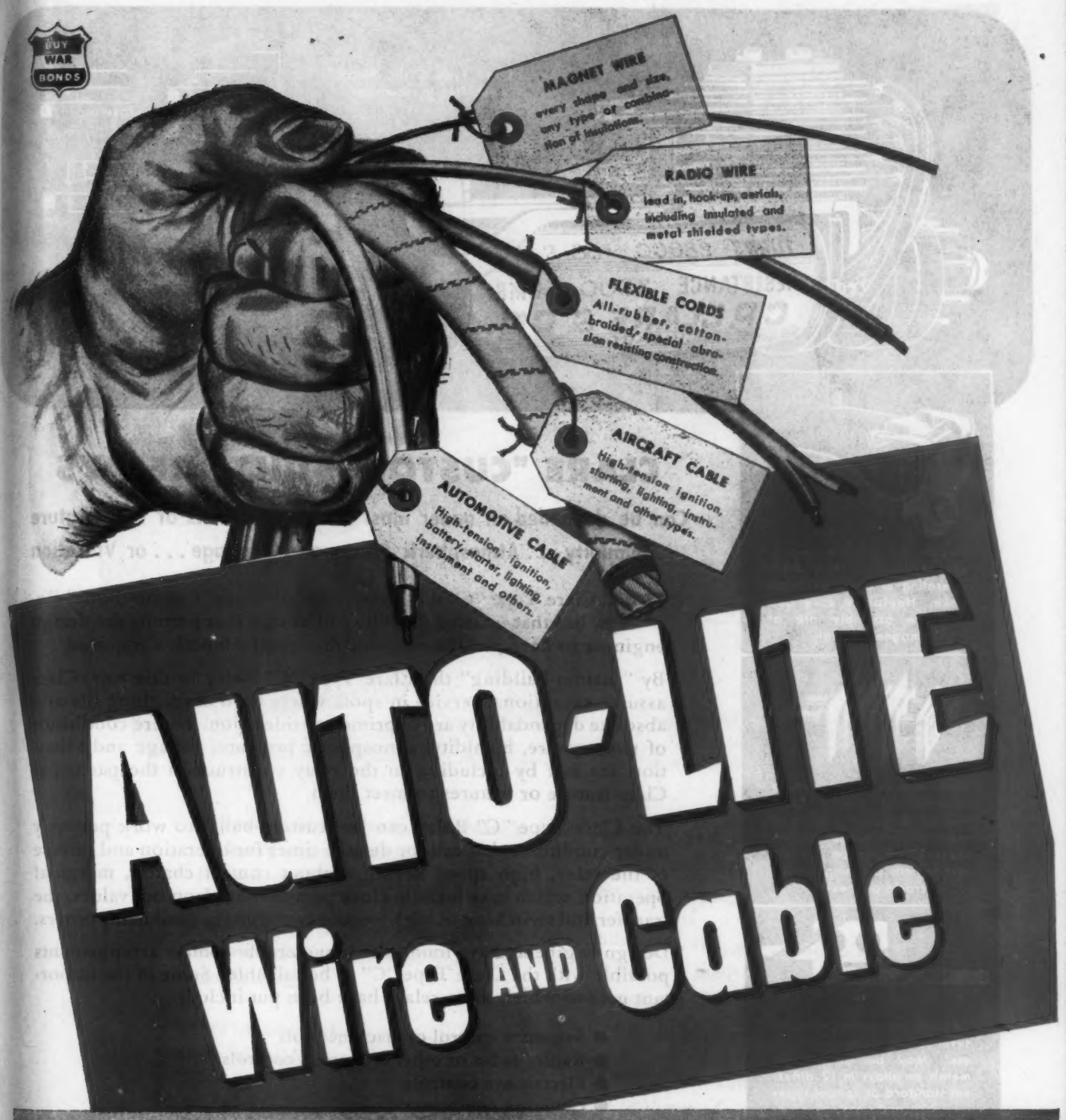
For the past four years, every ounce of our engineering and production experience has been at work for Uncle Sam. Postwar American industry will naturally seek to draw on the *know-how* developed during the war. Ours applies not only to communications, but to the general field of electronics and precision electrical engineering and manufacturing. If you have a problem involving communications, product improvement, product control, ignition, or the manufacture of precision electrical devices, our particular *know-how* is at your disposal.

CONNECTICUT TELEPHONE & ELECTRIC DIVISION

GREAT AMERICAN INDUSTRIES, INC.

MERIDEN, CONNECTICUT

TELEPHONIC SYSTEMS • SIGNALLING EQUIPMENT • ELECTRONIC DEVICES • ELECTRICAL EQUIPMENT • HOSPITAL AND SCHOOL COMMUNICATIONS AND SIGNALLING SYSTEMS • IGNITION SYSTEMS


BUY WAR BONDS
MAGNET WIRE
every shape and size, any type or combination of insulations.
RADIO WIRE
lead in, hook-up, aerials, including insulated and metal shielded types.
FLEXIBLE CORDS
All-rubber, cotton-braided, special abrasion resisting construction.
AIRCRAFT CABLE
High-tension ignition, starting, lighting, instrument and other types.
AUTOMOTIVE CABLE
High-tension, ignition, battery, starter, lighting, instrument and others.

AUTO-LITE Wire AND Cable

Custom made to fit your wire job

Supplying the precise type of wire and cable to meet the specific problem of your product is a speciality of Auto-Lite. Years of experimentation to achieve characteristics like increased heat resistance and improved performance lie behind every reel of Auto-Lite's electrical wire and cable.

Ample manufacturing facilities permit custom-made production whenever necessary, and a firmly established reputation for dependability assures specified performance.

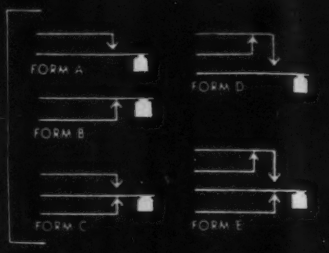
For help on any wire or cable problem that you may have, write to

THE ELECTRIC AUTO-LITE COMPANY

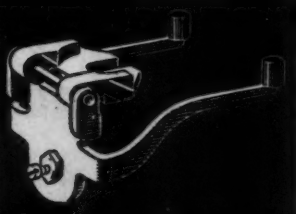
SARNIA, ONTARIO — *Wire and Cable Division* — **PORT HURON, MICH.**

TUNE IN "EVERYTHING FOR THE BOYS" STARRING DICK HAYMES—EVERY TUESDAY NIGHT—NBC NETWORK

Clare Type "C" d.c. Relay with Plug-In Mounting.



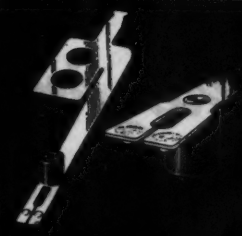
Contact springs employing any of these basic forms can be furnished.



Double arm armature assembly of stainless steel shaft, operating in a marine brass yoke. Heelpiece, core and armature assembly are of magnetic metal.

High voltage spring pile-up insulators of special heat-treated Bakelite. Has minimum cold flow properties, low moisture absorption content and permits punching without cracks or checks.

Contacts are welded to nickel silver springs by special process. May be of precious metals or alloys in 12 different standard or special types and sizes.



Spring bushing insulators are made of Bakelite rod under patented process. Resist vibration and withstand heavy duty service.

CLARE "CUSTOM-BUILT" RELAYS

Can be depended on under most severe conditions of Temperature . . . Humidity . . . Atmospheric Pressure . . . Voltage . . . or Vibration

THE Clare Type "C" d.c. Relay, like all Clare "Custom-Built" Relays, has that unusual flexibility of design that permits the design engineer to have just the relay for the specific function required.

By "custom-building" the Clare Type "C" Relay in this way, Clare assures exceptional service in spots where hard usage, long life and absolute dependability are of prime consideration. Severe conditions of temperature, humidity, atmospheric pressure, voltage and vibration are met by including in the relay construction the particular Clare feature or features to meet them.

The Clare Type "C" Relay can be "custom-built" to work perfectly under conditions that call for definite times for operation and release of the relay, high speed keying without contact chatter, marginal operation which may include close pick-up and drop-out values, the transfer and switching of high frequency circuits . . . and many others.

Design engineers have found the innumerable contact arrangements possible with the Clare Type "C" to be valuable. Some of the important uses to which these relays have been put include:

- Sequence control of machine tools
- Radio, radar or other electronic controls
- Electric eye controls
- Counting equipment
- Alarm systems

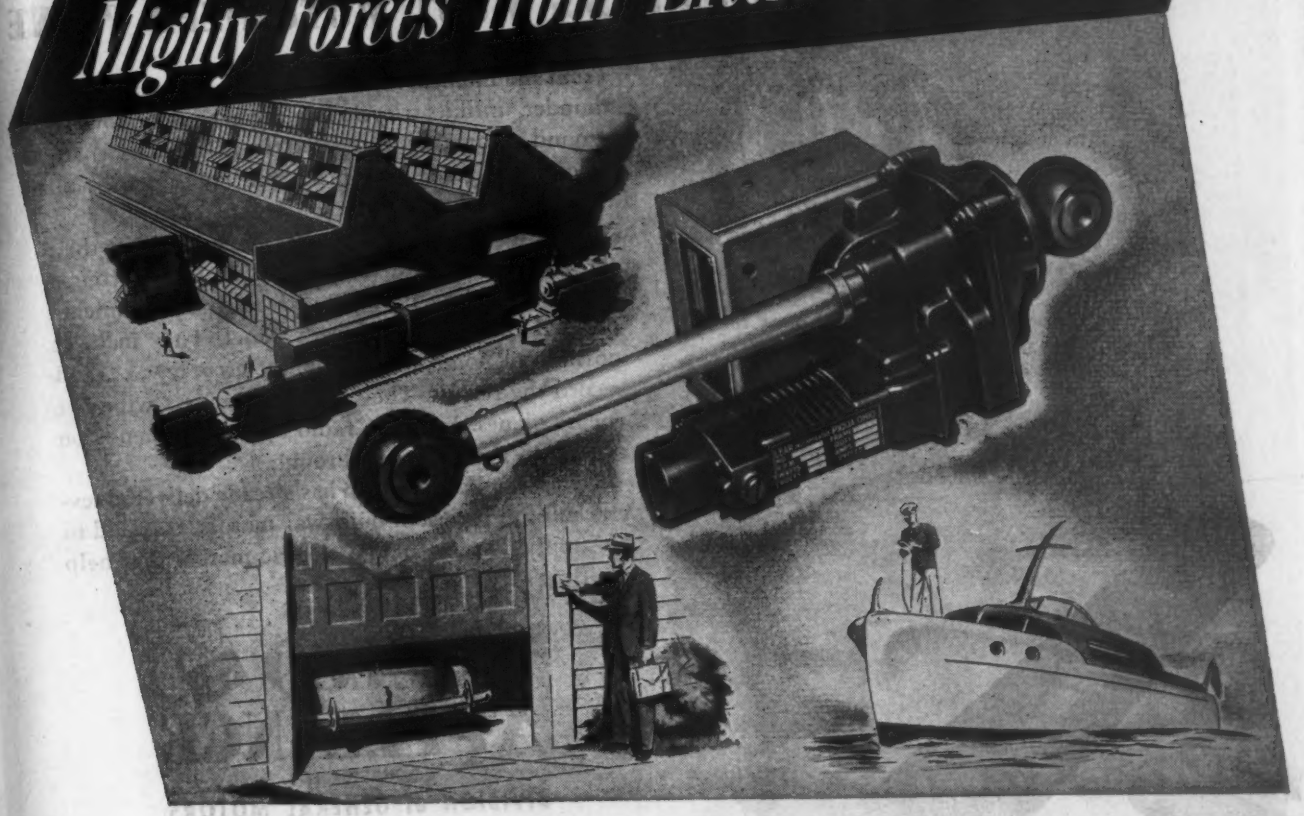
Pictured and described here are some of the special Clare construction features that make it possible for Clare Relays to so effectively reduce overall relay cost, simplify installation and insure better and more dependable performance.

Clare engineers are ready at all times to assist in developing a relay "custom-built" to your exact requirements. Send for the Clare catalog and data book. C. P. Clare & Co., 4719 West Sunnyside Avenue, Chicago (30), Illinois. Sales engineers in all principal cities. Cable address: CLARELAY.

CLARE RELAYS

"Custom-Built" Multiple Contact Relays for Electrical, Electronic and Industrial Use

Mighty Forces from Little Sources



IT TAKES a lot of oomph to work a plane's landing gear or its flaps and shutters. For loads run high at pursuit speeds.

It calls for sure-fire, precise action. Pilots must have hair-trigger response. There's no time for fussing.

Here you see some of the mighty midgets that were built to do these jobs.

They are called Lear Actuators. And they have been designed to be powerful, yet operate on a plane's limited electric current. They position accurately with a simple switch or with automatic controls. They're tough and strong, yet tip the scales in ounces or paltry pounds.

Other industries, too, are going to find important jobs for these precise, efficient little hard workers. We believe you might be interested in the work they can do.

That is why we tell you about them now. If you have a problem of precise control or of actuating with either linear or rotary motion get in touch with us. Our engineers are eager to give you the benefit of their experience.

PLANTS: *Piqua, Ohio, and Grand Rapids, Michigan*
BRANCHES: *New York, Los Angeles, Chicago, Detroit, Cleveland*

Lear INCORPORATED

Formerly Lear Avia, Inc.

The New 20th Air Force

FLIES THE WORLD'S MOST MOTORIZED PLANE

Wings that embrace the world form an emblem that fittingly symbolizes the global missions for which the new 20th Air Force was created

From the moment its four giant engines start their thunder, until its tricycle landing gear again touches ground, scores of tiny *electric motors,* of many types, help guide and make the Superfortress all that its name implies.

Electric Motors, many more precisely built than the finest watch, aid the pilot in setting his course . . . and holding it. They activate the instruments that fill the flight engineer's panel. They make it possible to bomb with pin-point accuracy . . . and record the results. They help the gunners wipe out enemy planes. Even the radio operator depends on motors to get messages through.

Delco Appliance, which has already delivered several million precision-built war motors, is proud to be supplying most of the electric motors that help the B-29's fly the world.

DELCO APPLIANCE

ROCHESTER, N. Y.

DIVISION of GENERAL MOTORS

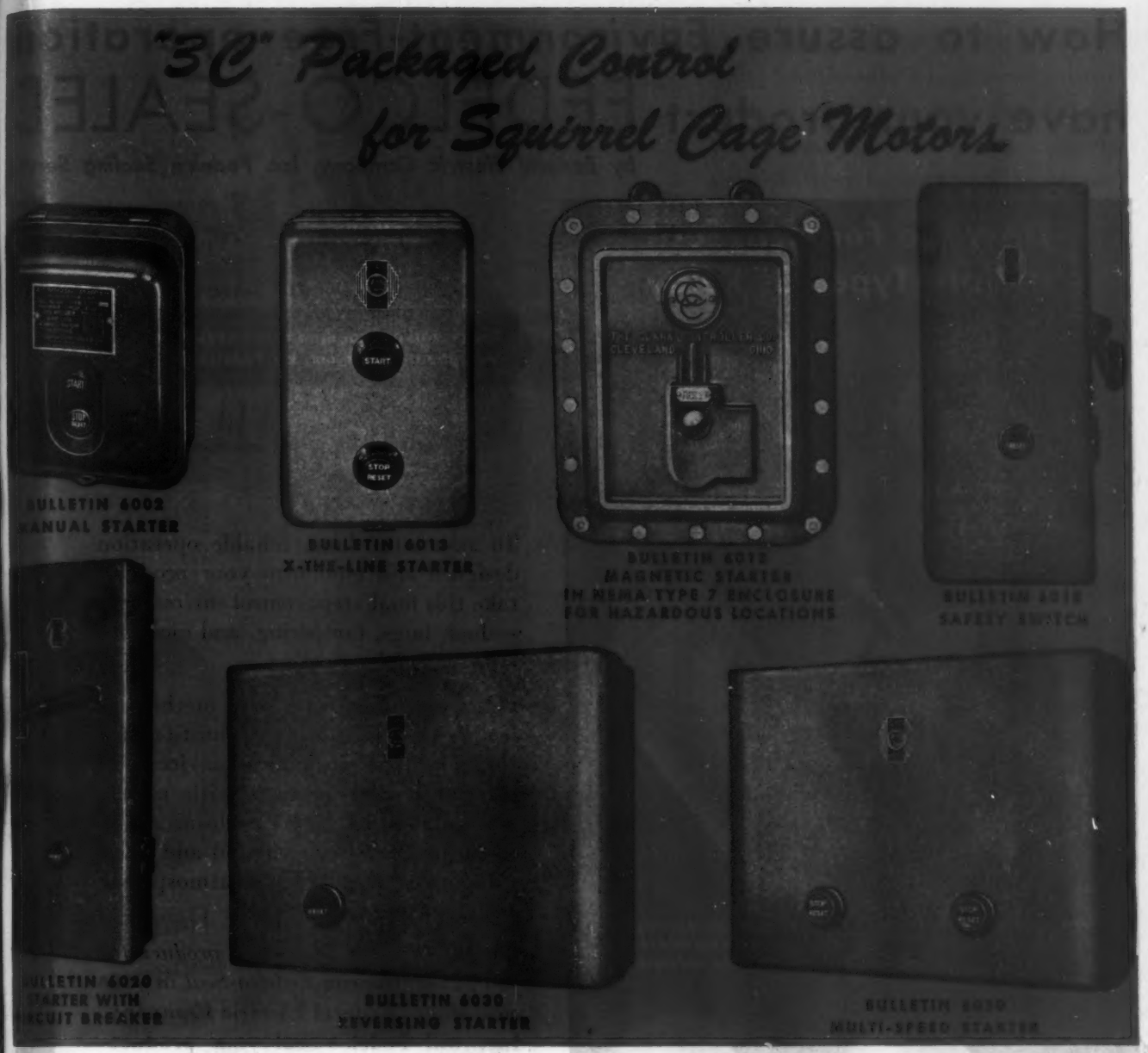
PEACETIME PRODUCTS: DELCO APPLIANCE MOTORS, DELCO AUTOMATIC HEAT (OIL-GAS-COAL) DELCO LIGHT AND POWER PLANTS, DELCO-LIGHT BATTERIES AND DELCO WATER SYSTEMS.

THE MORE BONDS YOU BUY THE MORE PLANES THEY FLY

A tiny Titan. One of the smallest motors of its capacity ever developed for high efficiency and continuous duty.

- Operates at speeds up to 25,000 r.p.m. (about ten times the speed of an airplane propeller).
- Operates efficiently in temperatures from 60° below zero to 150° above and from sea level to stratosphere.
- Advanced design permits motor speed to be governed within a range of plus or minus 1%.
- With a quarter-inch gear it will lift 50 times its own weight. Uses less current than an automobile taillight bulb.

A FEW OF MANY DELCO APPLIANCE MOTORS USED IN WAR AND WITH PEACETIME APPLICATIONS



"3C" Across-the-line Starters are sturdily built to give maximum service with minimum maintenance.

They are compact in size, yet there's plenty of wiring space in the cabinets, which are provided with concentric knockouts at top, side and back.

Magnets are vertical lift hinged armature type, with low operating current characteristics, and they won't close from accidental jarring.

Non-carbonizing Arc Shields—Thermal Overload Relays with External Reset—Silver-to-silver, double break N. O. or N. C. control circuit contacts—Arrangement for locking cabinets provided—These are some of the many features of "3C" A. C. starters.

OFFICES IN PRINCIPAL CITIES

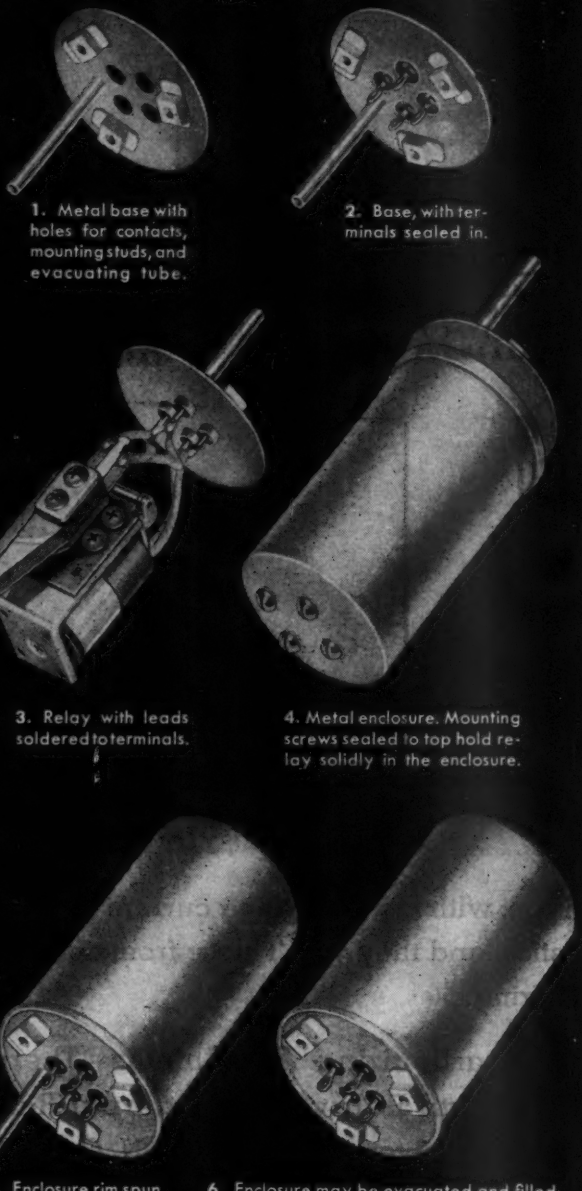
THE CLARK CONTROLLER CO.

1146 EAST 152ND ST. CLEVELAND, 10, OHIO

How to assure *Environment-Free* operation: have your product FEDELCO-SEALED

by Federal Electric Company, Inc. Fedelco Sealing Service

How we Fedelco-Seal a Clare Type "G" Relay



1. Metal base with holes for contacts, mounting studs, and evacuating tube.

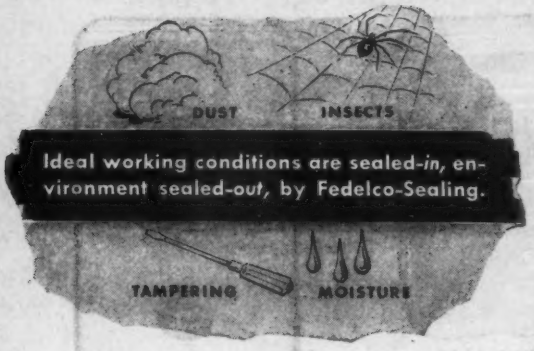
2. Base, with terminals sealed in.

3. Relay with leads soldered to terminals.

4. Metal enclosure. Mounting screws sealed to top hold relay solidly in the enclosure.

5. Enclosure rim spun over base and hermetically sealed.

6. Enclosure may be evacuated and filled with dry air, or inert gas, at atmospheric or higher pressure. Evacuating tube is sealed off, completing the Fedelco-Sealing process.



To assure the long, reliable operation designed and built into your product, take this final step: *control environment* —dust, bugs, tampering, and moisture —with Fedelco-Sealing.

Fedelco-Sealing is a new method of sealing-*in* ideal working conditions for electrical and mechanical devices. It surrounds your product with a hermetically-sealed metal enclosure. The enclosure may be evacuated and filled with dry air or inert gas, at atmospheric or higher pressure.

We can Fedelco-Seal your product for you . . . or you can Fedelco-Seal in your own plant. Federal Electric Company, Inc. will Fedelco-Seal your products and return them to you. Or you can do your own Fedelco-Sealing. Fedelco Engineers will show you how, by our own methods, with our equipment.

Get the details on Fedelco-Sealing—NOW

The use of Fedelco-Sealing is increasing rapidly. You will want to know about this method. Send us samples of your product to be sealed, or describe your product and your problem. Write or call any of the offices listed below.

FEDERAL ELECTRIC COMPANY, INC.

8700 South State Street, Chicago 19, Illinois • Phone VINcennes 5300

E. B. Mathewson Company, sales agents • 612 North Michigan Avenue, Chicago 11, Illinois • Phone WHItehall 4822

Sales offices: New York 17, N. Y.—Graybar Bldg. • Chicago 11, Ill.—612 N. Michigan Ave. • Philadelphia 7, Pa.—Real Estate Trust Bldg.
Kansas City 8, Mo.—2017 Grand Ave. • Atlanta, Ga. • Troy, N. Y.—17 Bank Street

THE EXTRA PROTECTION THAT ASSURES PERFORMANCE

SUNLIGHT MOTORS

SUNLIGHT MOTORS FOR:

AIR COMPRESSORS • WASHING MACHINES
POWER-DRIVEN BENCH TOOLS • IRONERS
MILK SEPARATORS • MILKING MACHINES
FURNACE BLOWERS • STOKERS • OIL BURNERS
WATER PUMPS • REFRIGERATORS
VENTILATORS • AND MANY OTHER APPLICATIONS

We Can't Let Up Now—
BUY EXTRA WAR BONDS

One feature alone did not give Sunlight fractional-horsepower motors their reputation for dependable performance. It is the accumulation of those features—the "extras" which mean so much to quality—that has long influenced scores of manufacturers to specify Sunlight motors in their products.

Those "extras" are based on a sound knowledge of what an electric motor needs for top performance under widely varying working conditions. They represent technical skill developed in manufacturing more than eight million Sunlight motors during 28 years . . . the design know-how that has eliminated all "bugs." This means a lot to users.

For extra protection Sunlight motors have:

1. *Extra-heavy coatings of dielectric insulation on all wiring—to guard against short circuits and the danger of burning out the motor.*

2. *Extra power through full-rated starting capacity —to prevent starting strains. Sunlight motors have up to three times the rated starting capacity, for safety.*

3. *Full-gauge copper wire—to reduce heat generation in armature and magnet.*

4. *Diamond-bored bearings—microscopically smooth —to provide trouble-free performance.*

5. *Self-oiling cast-bronze journals—to reduce friction and the chance of motor neglect. Sunlight motors require minimum servicing.*

Couple these "extras" with engineering know-how and extensive manufacturing facilities and you will know why Sunlight motors are specified to power many of the country's leading makes of electrical appliances.

DEPENDABLE APPLIANCE MOTORS FOR TWENTY-EIGHT YEARS

SUNLIGHT MOTORS

PRODUCT OF GENERAL MOTORS

PACKARD ELECTRIC DIVISION, GENERAL MOTORS CORPORATION, WARREN, OHIO

Variable Tuning Condensers, Push Button Tuning

Mechanisms and Actuators, Phonograph Record Changers

. . . and now speakers by G.I.

A NEW DIVISION
UNDER THE DIRECTION OF
LEE GOLDER
identified for more than 20 years with the manufacture of radio speakers.

Millions of radio components on the far flung battle areas of the world bear the G.I. insignia. What they have accomplished is already in the archives.

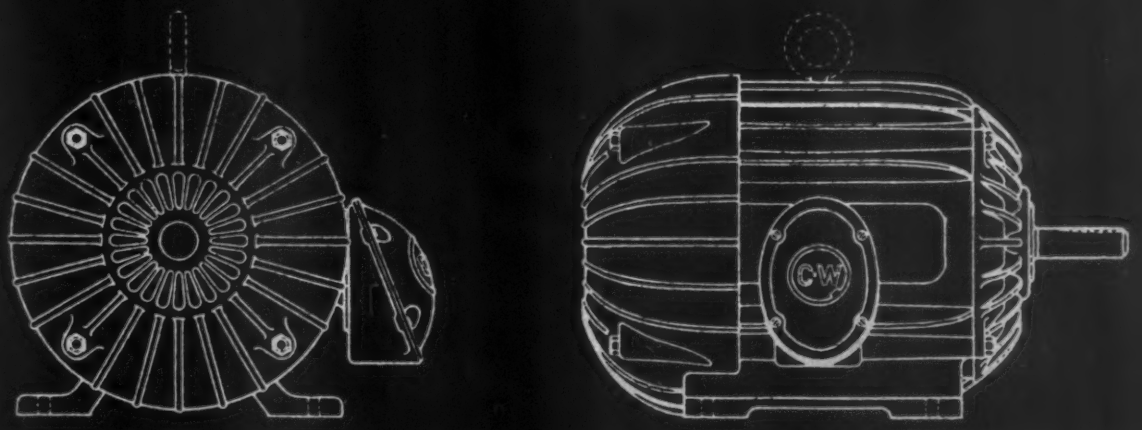
Behind General Instrument's record of achievement in the quantity production of electronic equipment for military use, stands nearly a quarter century of highly specialized production and experience in the field of radio components for home receiving sets.

The addition of a complete line of speakers is, therefore, not a venture into a new field, but the logical outgrowth of our expanded facilities, developed by wartime activities and increased resources in the radio equipment industry.

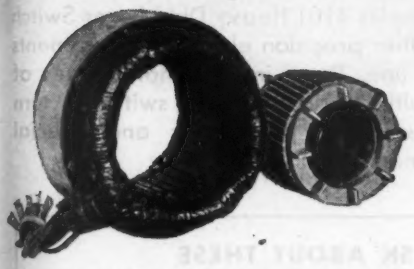
The resourcefulness and ingenuity—the expanded and perfected facilities that made this mammoth production possible will be put, without stint, behind our new speakers. Set manufacturers will know what this will mean.

GENERAL ELECTRONIC APPARATUS CORP.
A SUBSIDIARY OF
GENERAL INSTRUMENT CORP.
829 NEWARK AVE., ELIZABETH 3, N. J.

C-W POWER BLUE PRINT FOR YOUR POST-WAR PRODUCT!



SEALEDPOWER (COWL-COOLED) MOTOR—FOR ALL POLYPHASE ALTERNATING CURRENT CIRCUITS, 2 TO 15 HP NEMA DIMENSIONED.



These partial motors employ the same high grade vacuum impregnated insulation, rotor and stator construction that are inherent in the C-W standard squirrel caged machines. These motors are available from 208 to 550 volts, 2 or 3 phase, to 150 horsepower at 3600 r.p.m.

WHEN PEACE IS MADE—be prepared to produce that planned post-war product with adequate, dependable Crocker-Wheeler power. Our facilities and expert engineering knowledge will help you work out tomorrow's power system.

You will find efficiency and longer life in the pictured C-W squirrel cage SEALEDPOWER motors. Complete data on C-W AC Motors, DC Motors, AC Generators, DC Generators, Turbo-Generators, and Couplings is available at our nearest C-W office.

Whether your motor requirements are for standard or built-in machines, C-W engineering experience and service will help build your power blueprint now.

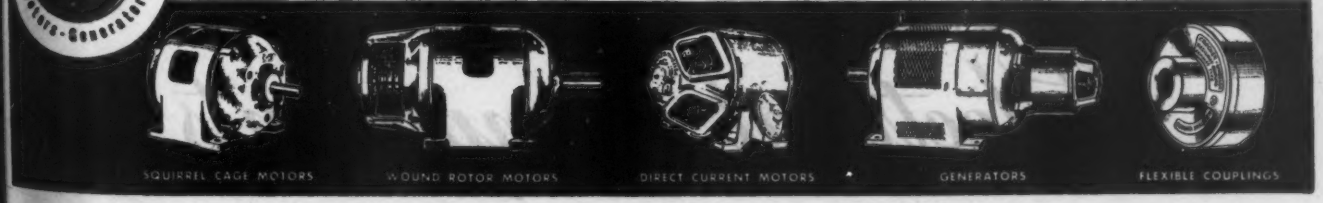
CROCKER-WHEELER

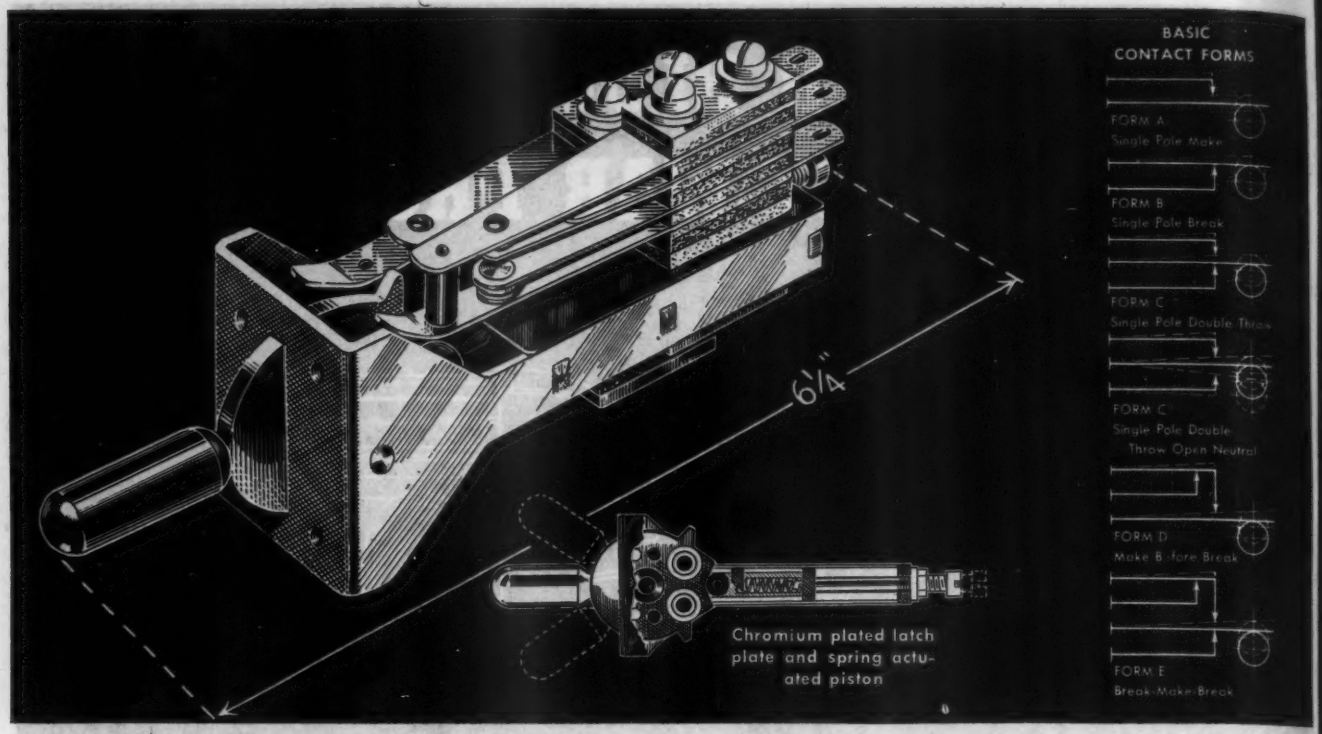
A Division of

JOSHUA HENDY IRON WORKS

AMPERE, NEW JERSEY

Branch Offices: BOSTON • BUFFALO • CHICAGO • CINCINNATI • CLEVELAND • DETROIT • NEW YORK • PHILADELPHIA • PITTSBURGH • SAN FRANCISCO • WASHINGTON • LOS ANGELES





A Big, Husky Switch That Locks Against Jar and Vibration

The Mossman Series 4101 Heavy Duty Lever Switch is a switch that locks for keeps. Once it is locked in position, no amount of jar and vibration can shake it loose.

A heavy brass frame, rigidly braced, gives the rugged construction necessary in many places where a heavy duty switch is required. This chassis supports a chromium plated latch plate and spring actuated piston in which a roller is mounted clevis fashion.

The Series 4101 is a three-position switch. Stops are set into the latch plate to effect locking, non-locking and no-throw positions. Lever action can be supplied with changes from three-position to two-position; also from locking to non-locking and vice versa.

Specific needs for contact arrangements are met by combinations of any of the six basic contact forms shown. Inverted forms may also be provided where space-saving is a factor.

Standard heavy duty contacts are of 3/16" diameter fine silver, rated at 10 amperes, 110 volts, a. c. (non-inductive). For extra heavy duty, contacts are of 5/16" silver alloy, rated at 20 amperes, 110 volts a. c., (non-inductive). Other contact materials are available to meet special conditions.

Send for the Mossman catalog for complete description of the Series 4101 Heavy Duty Lever Switch and the many other precision electrical components in the Mossman line. These include many types of heavy duty multiple circuit lever switches, turn switches, push switches, plug jacks and special switching components.

ASK ABOUT THESE MOSSMAN HEAVY DUTY SWITCHES

Series 6300 Heavy Duty Turn Switches
Meet the most exacting requirements for heavy duty, multiple circuit turn switches. Are available as both three position and two position switches.

Series 4200 Heavy Duty Lever Switches
Combine many of the outstanding features of the Series 4100 switches with lighter weight and more compact size. Frame is of zinc or aluminum die casting. Also available as three position or two position switches.

DONALD P. MOSSMAN, Inc., 612 North Michigan Avenue, Chicago (11), Illinois

MOSSMAN
"Electrical Components"

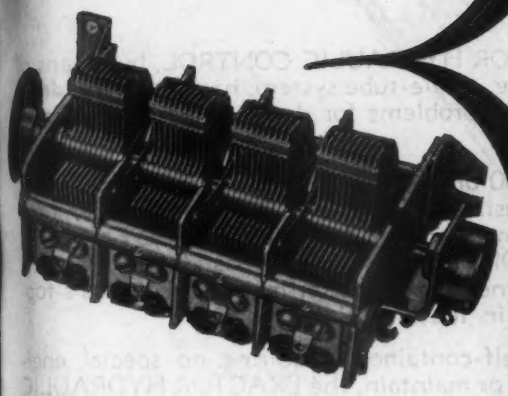
RECOMMENDED . . .

for your post-war radio

For distinct, accurate tuning, include in your post-war radio manufacture the variable air condensers and push button tuning devices of Radio Condenser Company.

The job these condensers are doing today in bringing every message *distinctly* and *accurately* to the men in our armed forces—should warrant your using them to assure the same distinct tuning in commercial sets.

Because of their recognition today, we heartily recommend them for your post-war radio.



RADIO CONDENSER CO.
CAMDEN, N. J.
RADIO CONDENSER CO. LTD., TORONTO, CAN.

. . . Doing a war job today

LET HYDRAULICS

SOLVE YOUR REMOTE CONTROL PROBLEMS!

Sperry's EXACTOR HYDRAULIC CONTROL, by means of a flexible, unique, single-tube system, has solved **hundreds** of remote control problems for design engineers in many industries.

With over 60,000 units now installed on marine, aviation, and general industrial equipment geared to war's demands for dependable, maintenance-free operation, the EXACTOR HYDRAULIC CONTROL is saving thousands of dollars and hundreds of engineering-hours for many of America's top-notch designers in these fields.

Accurate and self-contained, requiring no special engineering to install or maintain, the EXACTOR HYDRAULIC CONTROL is well worth investigating if **you** have a control problem involving the accurate transmission of applied motion over distances up to 200 feet.

Sperry's EXACTOR HYDRAULIC CONTROL is rated at 100 inch-pounds torque in either direction or as high as 400 inch-pounds in one direction.

SPERRY PRODUCTS INC.

HOBOKEN · · NEW JERSEY

FILL OUT AND MAIL COUPON BELOW. NO OBLIGATION!

P.E. E.H.C. 12-44

SPERRY PRODUCTS, HOBOKEN, NEW JERSEY

Gentlemen:

Please send me, at no cost, a copy of your Bulletin **78-D containing** complete details on your EXACTOR HYDRAULIC CONTROL.

NAME .....

TITLE .....

COMPANY .....

ADDRESS .....

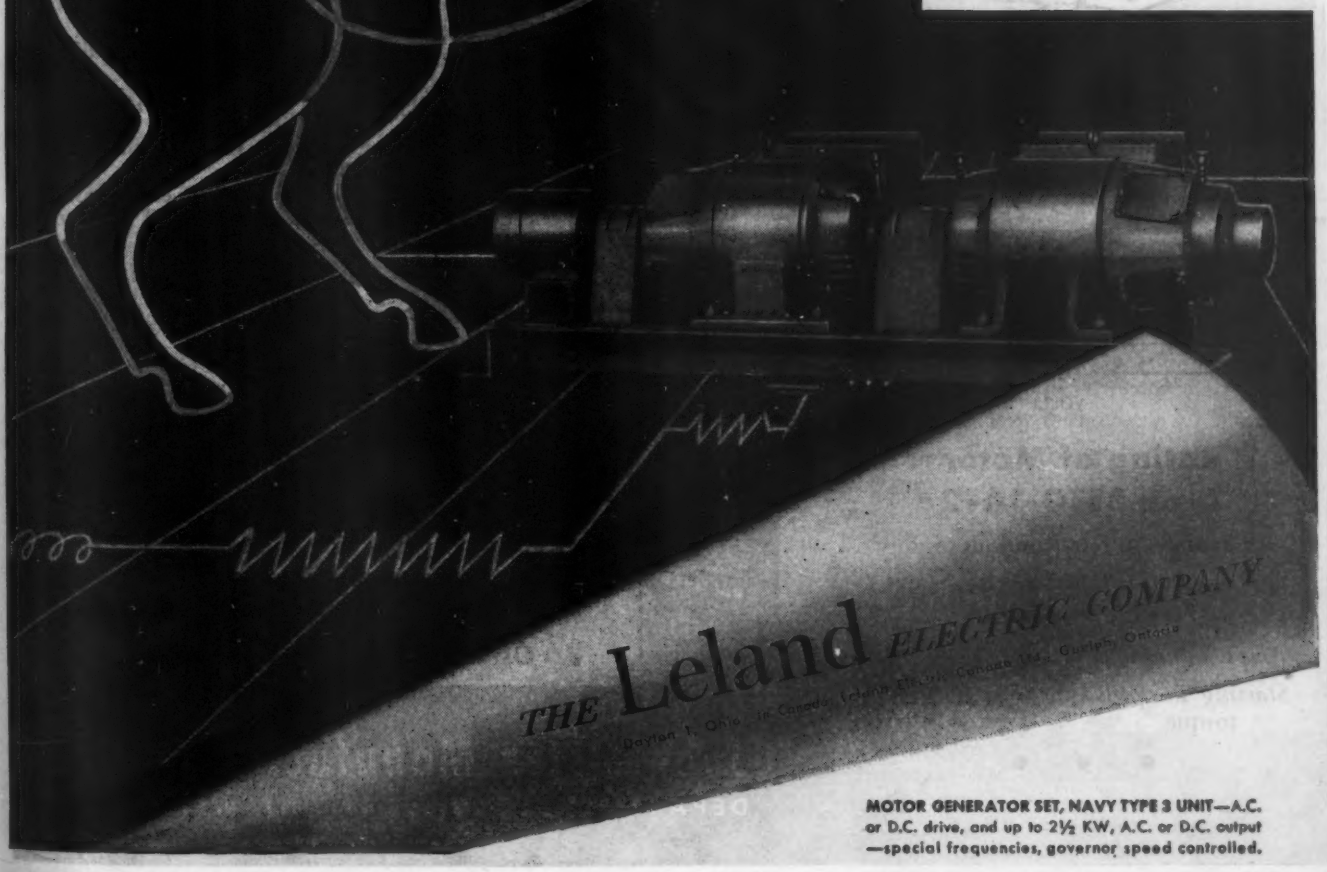
CITY .....

STATE .....

CREATIVE ELECTRICAL ENGINEERING

Industry is entering an era of electronics, marked by the keenest competition in business history. The rich rewards will surely go to those who employ *Creative Electrical Engineering* to best advantage.

In this highly technical field, LELAND Electric has solved many difficult electrical problems with skill and ingenuity. This valuable experience may be the key to your post-war plan. We invite your inquiry.



MOTOR GENERATOR SET, NAVY TYPE 3 UNIT—A.C. or D.C. drive, and up to 2½ KW, A.C. or D.C. output —special frequencies, governor speed controlled.

This Governor-Controlled Oster Motor

Gives You the New Design and Operating Advantages of CONSTANT SPEED

Here is a new Oster development in a constant speed, governor-controlled motor that backs up your good judgment when you specify it for applications where constant speed is a necessity. This motor is now in production and deliveries can be made in the very near future. Here are the features that assure you of satisfaction:

Housing: Die cast aluminum end brackets. Mild steel field housing. Totally enclosed.

Finish: Black anodized end brackets. Cadmium plated field housing.

Weight: 15 Oz.

Bearings: Single shielded ball bearings, lubricated with a grease suitable for any specific application. Bearing housings fitted with steel inserts.

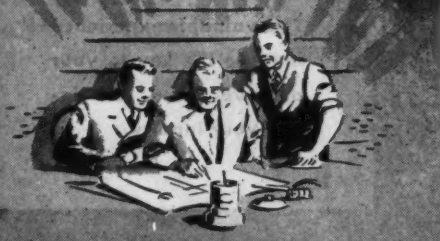
Windings & Insulation: Field coils and armature wound with a select grade of insulated copper wire and impregnated with a high quality heat and moisture resisting insulating varnish.

Brushes: Equipped with high grade metal graphite brushes. Beryllium copper brush springs.

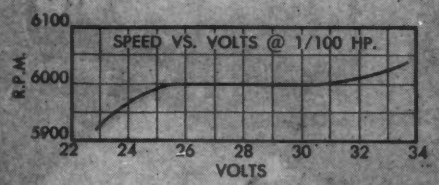
Governor: Furnished with a centrifugal governor to maintain constant speed over a voltage range of 25 to 30 volts.

Temperature Rise: Maximum frame temperature rise at rated output will not exceed 55° C.

Modifications: Motors can be furnished with special shaft extensions, mounting arrangements, finishes, leads, etc. All modified units are considered special.



When designing your post-war product, consider this new Oster development in applications where constant speed is a nesessity . . .



Rating of Motor Type BSTG-1A-2

Horsepower—1/100 continuous duty

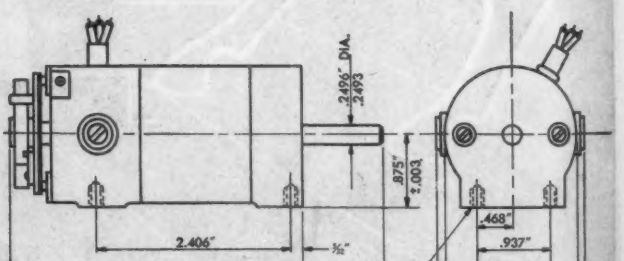
Speed—6000 R.P.M. ± 1%

Voltage—25-30 volts D.C.

Amps. input—.95

Starting Torque—300% of full load torque

• • •



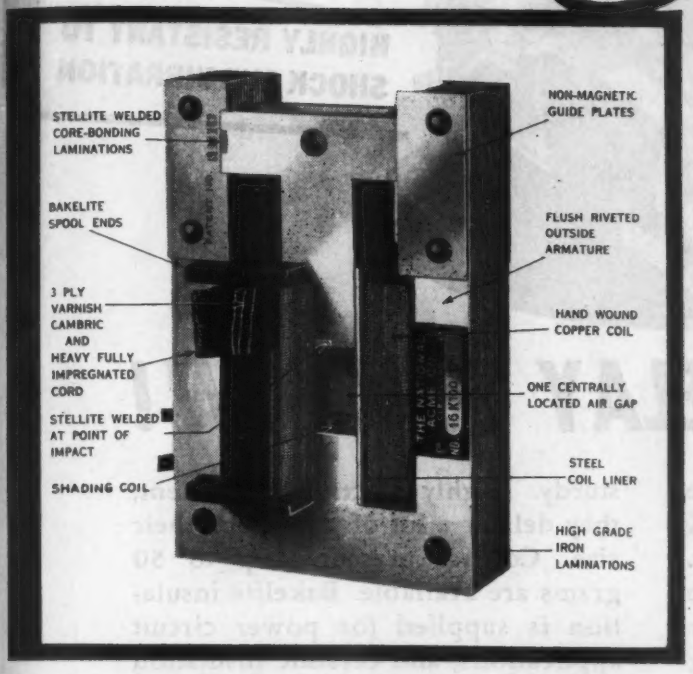
Let us help you fit this and other Oster Motors to your requirements.

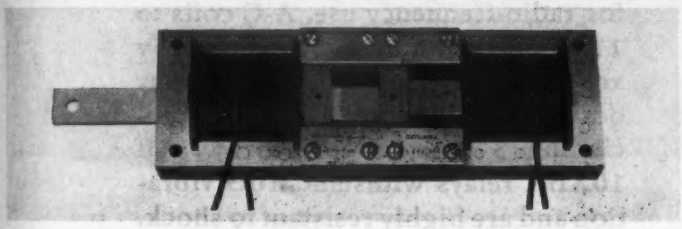
M-22

John Oster Manufacturing Co.

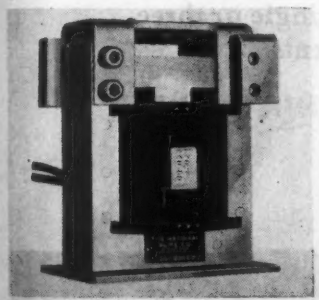
DEPARTMENT P-22 • RACINE, WISCONSIN

ANSWERS TO QUESTIONS ABOUT *Solenoids*

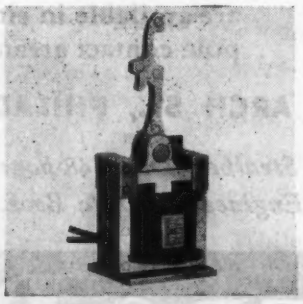

STELLITE WELDED CORE-BONDING LAMINATIONS
BAKELITE SPOOL ENDS
3 PLY VARNISH CAMBRIC AND HEAVY FULLY IMPREGNATED CORD
STELLITE WELDED AT POINT OF IMPACT
SHADING COIL
NON-MAGNETIC GUIDE PLATES
FLUSH RIVETED OUTSIDE ARMATURE
HAND WOUND COPPER COIL
ONE CENTRALLY LOCATED AIR GAP
STEEL COIL LINER
HIGH GRADE IRON LAMINATIONS



Double Solenoid for forward and reverse of hydraulic valve.



Valve operating Solenoid with leather-faced plunger stop.



Ratchet indexing Solenoid used in Electric Counters.

1 Solenoids make use of the electro-magnet principle to operate devices that require *push* or *pull* motion.

2 The Solenoid principle is not new, but war production has developed many important new applications.

3 Some of the uses of Solenoids—many of them presenting new and original engineering—that have been developed by National Acme are:

Actuate clutches	**Move levers**
Operate switches	**Operate valves**
Machine controls	**Vibrate cutting knives**
Gun firing mechanisms	**Open and close doors**
Operate safety devices	**Holding chucks**
Eject work in process	**Hopper opening and closing**
Clamping devices	**Sorting inspected parts**

4 Solenoids are space-saving, dependable, easy to install, can be remote-controlled, often eliminate more complex mechanisms and make machines more automatic.

5 National Acme engineers design and build a wide variety of Solenoids in capacities from 4 to 35 lbs. push or pull.

Inquiries involving special problems that arise from your new designs, or for more dependable performance on old applications, are welcomed.

For standard Solenoids, ask for Bulletin EM-41.

ELECTRICAL MANUFACTURING DIVISION

THE NATIONAL ACME CO.

170 EAST 131ST STREET • CLEVELAND 8, OHIO

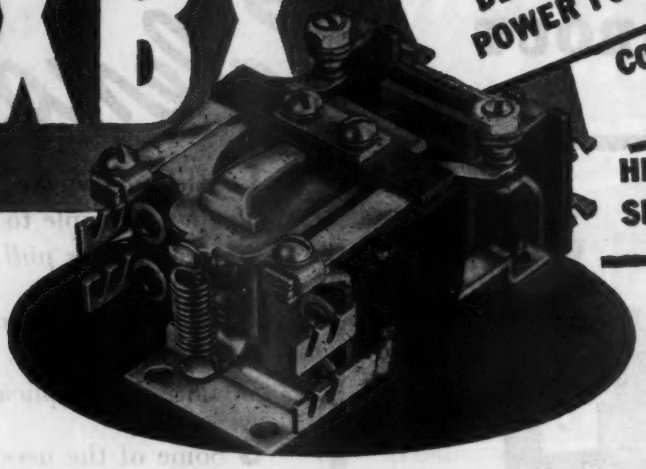
ACME-GRIDLEY 4-6 AND 8 SPINDLE BAR AND CHUCKING AUTOMATICS • SINGLE SPINDLE AUTOMATICS • AUTOMATIC THREADING DIES AND TAPS
THE CHRONOLOG • LIMIT, MOTOR STARTER AND CONTROL STATION SWITCHES • SOLENOIDS • CENTRIFUGES • CONTRACT MANUFACTURING

10XBX

DELIVERS A LOT OF POWER FOR ITS SIZE

COVERS A WIDE RANGE OF APPLICATIONS

HIGHLY RESISTANT TO SHOCK AND VIBRATION



. . . A GOOD RELAY TO KNOW!

If any Relay type ever deserved the name "All-Purpose" it is Type 10XBX of the Struthers-Dunn 10-frame series. While new and special types come and go, this popular 2P. D.T. relay continues in heavy favor with leading users to whom its extreme versatility on a wide range of applications holds strong appeal. From audio frequency circuits to motor control circuits; from naval battle announcing stations where shock resistance is important, to aircraft use where vibration is a big factor, 10XBX relays are performing competently and well.

These relays are light, small, and sturdy. Highly electrically efficient, they deliver a lot of power for their size. Contact pressures up to 50 grams are available. Bakelite insulation is supplied for power circuit applications, and ceramic insulation for radio-frequency use. A-C coils to 115v, 60 cycles; or d-c coils to 115v are available. Contacts may be in any desired combination up to and including 3 pole, double throw. All 10XBX relays withstand 10G vibration and are highly resistant to shock. Other relays of the 10-frame series are available in either single or three pole contact arrangements.

STRUTHERS-DUNN, Inc., 1321 ARCH ST., PHILADELPHIA 7, PA.

WRITE *for the big Struthers-Dunn 48-page Catalog and Relay Engineering Data Book.*

STRUTHERS-DUNN

5,312 RELAY TYPES

DISTRICT ENGINEERING OFFICES: ATLANTA • BALTIMORE • BOSTON • BUFFALO • CHICAGO • CINCINNATI • CLEVELAND DALLAS • DENVER • DETROIT • HARTFORD • INDIANAPOLIS • LOS ANGELES • MINNEAPOLIS • MONTREAL NEW YORK • PITTSBURGH • ST. LOUIS • SAN FRANCISCO • SEATTLE • SYRACUSE • TORONTO • WASHINGTON

The Howell Protected Type Motor, shown, gives complete protection against dripping liquids, metal chips and other falling particles. Completely streamlined—utilizing non-breakable steel frame—malleable or steel base—cast iron end plates and cast iron, weatherproof terminal box are standard construction features. Special horizontal and vertical mountings are available.

Available in sizes 5 H.P. and smaller.

The tens of thousands of owners who already have Howell Motors are "walking on air." Producers do like quality.

But, we all know the entire electric motor industry is confronted with a serious situation today. Demands for motors are up. Manpower is short. Materials are scarce.

While we are swamped with orders for Howell Motors, we have flatly refused to skimp on quality in order to speed production. However, we fully recognize our obligation to put forth the maximum effort in serving our customers NOW! This, we are doing.

Buy Horsepower by

HOWELL ELECTRIC MOTORS COMPANY

HOWELL, MICHIGAN

Manufacturers of Quality Motors Since 1915

Increased Power and Constant Speed

...YET FITS MOTOR SPACE AVAILABLE

Typical Recorder Powered with Holtzer-Cabot Motor

The requirements of a manufacturer of instruments called for a constant speed motor that had more power than a standard clock motor previously used, yet still fitted the original space allowed.

Holtzer-Cabot designed the special synchronous motor, illustrated above, which not only filled the performance and space requirements, but saved the manufacturer the cost of redesigning and retooling to take a larger motor, and also made it possible to service instruments in customers' plants which had the old type of motor.

The specialized business of Holtzer-Cabot is the designing and building of special fractional H. P. motors to meet special requirements.

Although today our entire facilities are devoted to building special motors for military use, our motor development engineers will gladly discuss your post-war fractional H. P. motor requirements with you.

Special Motors Designed to Fit the Application

HOLTZER-CABOT

Division of First Industrial Corporation

Designers and Builders of Special Fractional HP Motors and Electrical Apparatus

125 AMORY STREET, BOSTON 19, MASSACHUSETTS • CHICAGO, ILLINOIS • NEW YORK, NEW YORK • PHILADELPHIA, PENNSYLVANIA

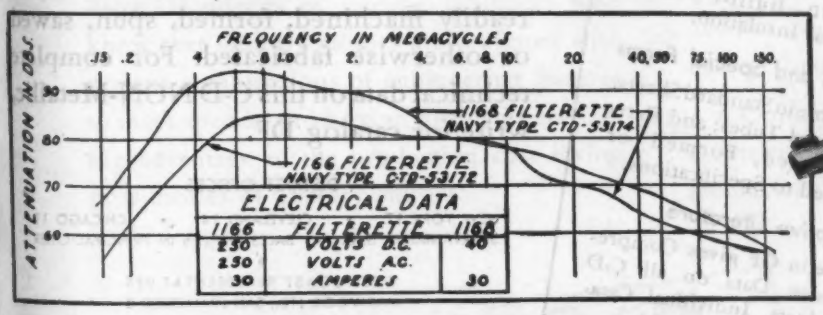
IN THE FIELD OF RADIO NOISE ELIMINATION TOBE IS THE ACKNOWLEDGED LEADER

One engineering result of the war is increased knowledge of radio interference problems. It will never be lightly treated again. No engineer can tackle the development of an electrical design without giving due consideration to minimizing the radio interference it creates in operation. Specially designed filters, to be built into electrical circuits, can usually solve the problem of radio interference.

Here at Tobe is a great storehouse of knowledge in this subject. It is *sound* knowledge, gained by the most intense interest and experience of any company in the field.

Tobe Filterizing is a copyright term. It means that Tobe knows how to "filterize" man-made radio noise. Why not make use of this valuable 16 years' of experience in your own engineering? Place your reliance on Tobe and the famous Tobe Filterettes. Send us your problems now.

LONG LIFE ASSURED!



CONTAINER DIMENSIONS

Length . . 4 7/16" Width . . 2 1/8" Height . . 2 7/8" Overall length 6 1/4"

SUPPRESS MAN-MADE RADIO STATIC

TOBE FILTERIZED

Tobe Deutschmann Corporation
CANTON, MASSACHUSETTS

A small part in Victory Today — A BIG PART IN INDUSTRY TOMORROW

Continental-Diamond
Engineered Dielectric Materials

KA-14

DIAMOND
Vulcanized Fibre

The DIAMOND Vulcanized Fibre part illustrated is a handle for a welder's torch. It is made from tubing. DIAMOND Vulcanized Fibre is used for this part because DVF is tough, strong and light in weight... because it insulates electrically and thermally. The handle is economically made from DVF because DVF is readily machined, formed, spun, sawed or otherwise fabricated. For complete technical data on this C-D NON-Metallic, write for catalog DF.

C-D PRODUCTS

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DILECTO—A Laminated Phenolic.
CELORON—A Molded Phenolic.
DILECTENE—A Pure Resin Plastic Especially Suited to U-H-F Insulation.
HAVEG—Plastic Chemical Equipment, Pipe, Valves and Fittings.

The NON-Metallics

DIAMOND Vulcanized FIBRE
VULCOID—Resin Impregnated Vulcanized Fibre.
MICABOND—Built-Up Mica Electrical Insulation.

Standard and Special Forms

Available in Standard Sheets, Rods and Tubes; and Parts Fabricated, Formed or Molded to Specifications.

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Bulletin GF gives Comprehensive Data on all C-D Products. Individual Catalogs are also Available.

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Established 1895. . Manufacturers of Laminated Plastics since 1911—NEWARK 40 • DELAWARE

Century is helping to meet

INDUSTRY'S No. 1 PROBLEM

—Making more jobs by helping manufacturers
make more and better products at a lower cost.

Tough job? Sure! But American industry and ingenuity will do it!

The manufacturers of machine tools and other types of processing equipment are modernizing their designs with one purpose in mind—to help John Q. Public get more and better products at a lower cost.

Business realists realize that this is the only *practical* method of opening the public's purse strings—and thus, through stimulated demand, build increased production and more jobs.

Electric motors are production tools, too—a component part of the production tools they drive. Hundreds of leading designers who know that Century motors are designed with various combinations of engineering features to meet specific production problems are taking advantage of the production cost saving possibilities of Century motors.

Century's national organization of motor specialists is helping production machinery and appliance manufacturers effect savings in original design, as well as savings in production output.

This means that the *entire business public*—from the manufacturers of production equipment down through the fabricators of thousands of products, the wholesaler and retailer—all of whom are trying to deliver a better product to the final user at a lower cost—have a direct or indirect stake in how well the Century organization does its job of helping others to make more jobs.

If you are a manufacturer of motorized production equipment or appliances—call the nearest one of Century's 31 branch offices.

A Century Motor Specialist can be of greatest help while your design is in the experimental or drafting board stage.

Century C MOTORS

CENTURY ELECTRIC COMPANY · 1806 Pine Street, St. Louis 3, Missouri
Offices and Stock Points in Principal Cities

THE Telechron Pre-Selector shown here is an important development for post-war radios. It's low in cost — recommended for use with moderate-price receivers.

Buyers will like this easy-to-use Pre-Selector, with finger-tip control. Each of the 48 keys around the Telechron clock dial represents a 15-minute timing interval. Pulling out a key automatically turns the receiver on, at the pre-selected station, for 15 minutes—and off at the end of the period, unless the next key is pulled out also. Keys are automatically reset to OFF position after timing periods are passed.

A flick of the finger sets the keys around the large and legible clock face. There are no knobs to turn, no complicated settings, no difficult calculating. Settings can be made as much as 10 hours in advance.

This Telechron Pre-Selector is only one of a full line of automatic timing and control devices which we can supply for post-war home appliances. All use the famous self-starting, synchronous Telechron motors and movements. For full information about Telechron timers, wire or write Automatic Control Division, Dept. H.

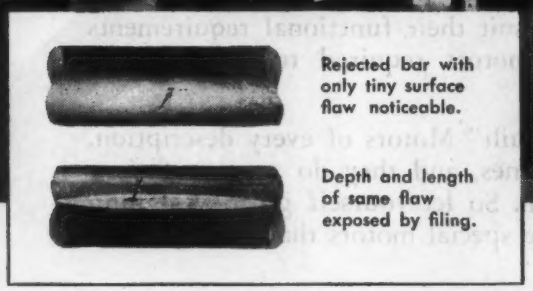
ANOTHER TELECHRON TIMER
THE TELECHRON SIGNAL TIMER
works on the alarm clock principle. It's used for range, radio, and other home appliances where on or off timing is needed. It has both switch and audible features. We also have regular clock movements for any size receiver.

Telechron
REG. U. S. PAT. OFF.

WARREN TELECHRON COMPANY • ASHLAND, MASSACHUSETTS

SPERRY ELECTRONIC FLAW DETECTOR

saves $2000 per week in tool breakage!



Rejected bar with only tiny surface flaw noticeable.

Depth and length of same flaw exposed by filing.

Each bar can be inspected at the rate of 80 feet per minute or more. Flaws or inclusions as short as 1/16-inch are detected electronically.

How RCA Electron Tubes Help Locate Hidden Flaws in Bar Stock

THIS is the story of a New England manufacturer* who used electronic inspection to solve his problem of excessive tool breakage.

In machining parts from brass bar stock, invisible flaws and inclusions in the brass caused tool breakage costing over $2000 per week.

To solve the problem, an electronic flaw detector, developed and manufactured by Sperry Products, Inc., Hoboken, N. J., was purchased to inspect all stock before machining. The new inspection method detects defects which would cause tool damage and resulting shut-down. In the first six weeks of operation, *not one tool was broken, tool wear was sharply reduced, and production increased 60%!*

How Does It Work? The Sperry electronic flaw detector consists of an electron-tube oscillator, a detector coil, and a sensitive electron-tube indicator. The oscillator supplies alternating current to the detector. The brass is passed through the detector (see photo). If a flaw is present, the indicator circuit signals the operator and stops the machine. Seventeen small RCA electron tubes are used.

*Name on request

Defects as short as 1/16-inch can be located in both ferrous and non-ferrous materials. The detector works equally well on welded or seamless tubing and on bar stock, and locates external or internal defects, such as splits, seams, and inclusions.

Advantages: In addition to preventing damage to tools and machines, automatic electronic detection improves product quality, reduces final inspection rejections, and prevents failures in the field caused by defective material.

For Further Information on the electronic flaw detector write to Sperry Products, Inc., Hoboken, N. J. If you have some *other* problem involving the use of electron tubes, RCA tube application engineers will be glad to help you or to put you in touch with a manufacturer who can.

For a copy of the free 32-page booklet "Electrons in Action at RCA" which shows electronic devices at work in our own factories, write to Radio Corporation of America, Dept. 62-18P, Harrison, N. J.

Remember, the Magic Brain of all electronic equipment is a Tube . . . and the fountain-head of modern Tube development is RCA!

1919-1944
25 Years of Progress in Radio and Electronics

RCA

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RADIO CORPORATION OF AMERICA

RCA VICTOR DIVISION · CAMDEN, N. J.

WE BUILD MOTORS *to Conform to* YOUR MACHINE DESIGN

Design and build your machines to suit their functional requirements and don't worry about the electric motors required to power them. Because that is our job.

We specialize in building "Custom-built" Motors of every description. They're built to conform to the machines, and they do a very efficient and outstanding job of powering them. So let yourself go in designing your machines. We'll build for you the special motors that will conform to those designs.

You'll be particularly pleased with the *Inter-changeable Feature* of Welco Torque Motors, because the Welco A.C. motor will fit where the D.C. motor fits, and vice versa. This exclusive feature is particularly valuable to the machine builder whose designs conform to the modern trend of built-in construction and remote control.

For thirty-five years specialists in custom-built torque motors, any size up to 75 H.P. for any application.

Write for full details.

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Made in One Piece . . .

by STUPAKOFF

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Backed by two generations of experience in the manufacture of precision ceramics, Stupakoff engineers will give dependable assistance in developing insulators for your electronic apparatus. An inquiry will put our technical knowledge and manufacturing facilities at your disposal.

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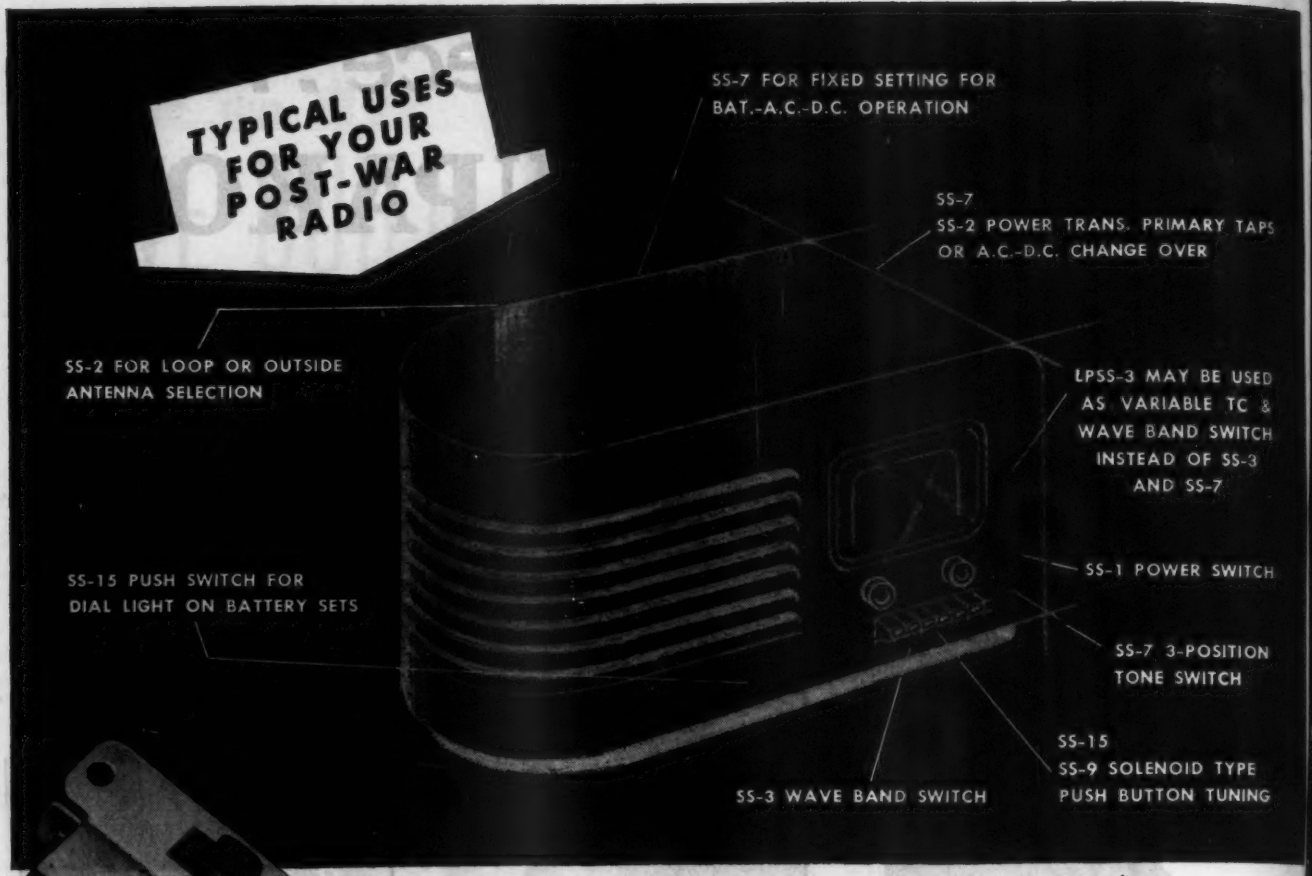
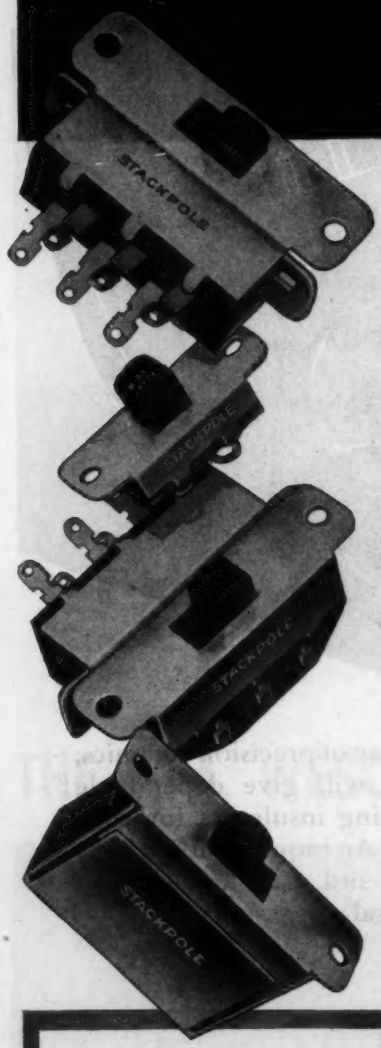
"FOR GREAT ACHIEVEMENT"

STUPAKOFF CERAMIC AND MANUFACTURING CO., LATROBE, PA.

Ceramics for the World of Electronics


TYPICAL USES FOR YOUR POST-WAR RADIO
SS-7 FOR FIXED SETTING FOR BAT.-A.C.-D.C. OPERATION
SS-7
SS-2 POWER TRANS. PRIMARY TAPS OR A.C.-D.C. CHANGE OVER
SS-2 FOR LOOP OR OUTSIDE ANTENNA SELECTION
LPSS-3 MAY BE USED AS VARIABLE TC & WAVE BAND SWITCH INSTEAD OF SS-3 AND SS-7
SS-15 PUSH SWITCH FOR DIAL LIGHT ON BATTERY SETS
SS-1 POWER SWITCH
SS-7 3-POSITION TONE SWITCH
SS-15
SS-9 SOLENOID TYPE PUSH BUTTON TUNING
SS-3 WAVE BAND SWITCH



THE SWITCHES OF HUNDREDS OF APPLICATIONS

Line, Slide, Rotary-Action Types Inexpensive but Dependable

FROM post-war radio equipment to toys; from instruments to appliances, Stackpole switches afford a complete engineering selection. They are compact, dependable, low in price, and are subject to countless adaptations designed to match your specifications *exactly*.

Standard types include 1-, 2-, 3-, and 4-pole styles, with or without spring return, detent, or other optional features. 3-position and various other types are available. Write today for a copy of the 36-page Stackpole Electronic Components Catalog including Switches, Fixed and Variable Resistors and Iron Cores for a variety of uses.

STACKPOLE CARBON COMPANY, St. Mary's, PA.

STACKPOLE

OTHER STACKPOLE PRODUCTS

BRUSHES - CONTACTS (*All carbon, graphite, metal, and composition types*)
POWER TUBE ANODES
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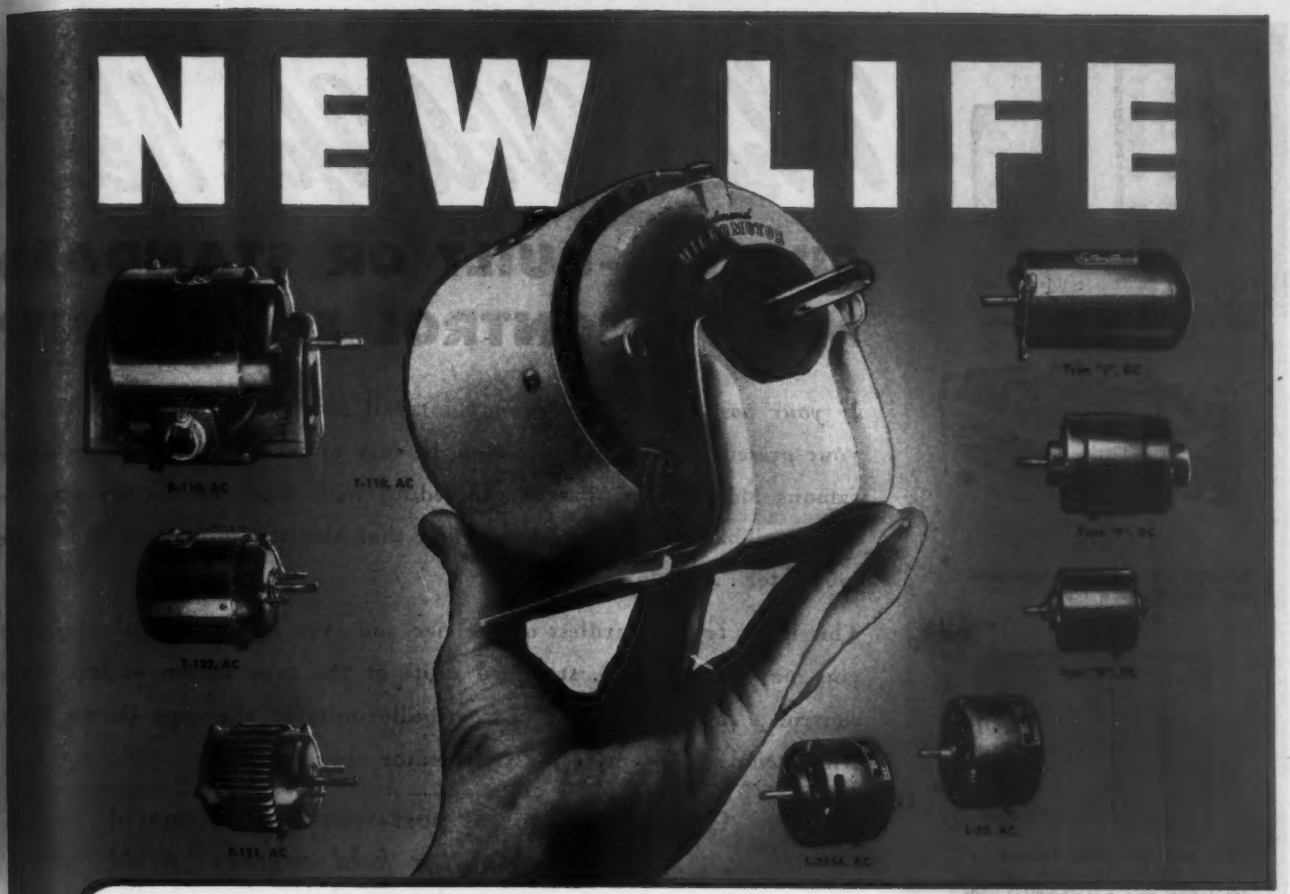
NEW LIFE



FOR YOUR POSTWAR PRODUCTS...
Redmond MICROMOTORS

ADD new life to your products with Redmond Micromotors, built in sizes up to a tenth horsepower.

Add the revealing touch of experience—accomplishment by specialists—the magic of precision on a mass production basis.

Get the exclusive Redmond patents and original Redmond developments. Take advantage of Redmond's 18 active years of effort concentrated on micro-power and its varied applications.

Learn all about these fine Micromotors, their long life, consistently low operating cost, and low first cost. *Write us today.*

Shaded Pole AC Micromotors are built in sizes up to 1/20th horsepower. Series and Shunt Wound DC Micromotors are built in sizes up to 1/10th horsepower for operation at 6 to 115 volts. Micromotors can be tailor-made to meet unusual requirements.

REDMOND KNOWS MOTORS

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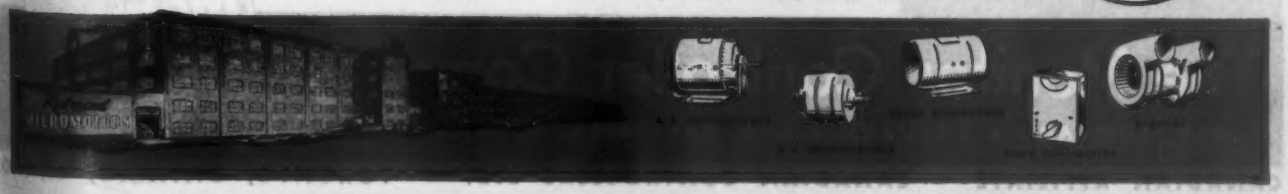
REDMOND

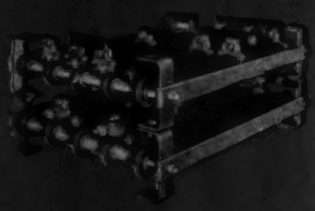
A. G. Redmond Company

Composite sketch of Redmond facilities with over 5 acres of floor area.

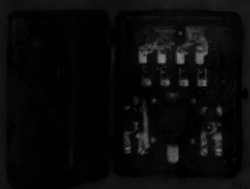
OWOSSO, MICHIGAN, U. S. A.



Push Button Control Stations of all types in General Purpose, Watertight and Weatherproof enclosures.

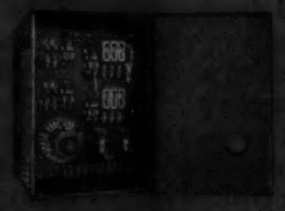


Resistors — Edgewound, Narrowband and Smoothwound types.



A.C. and D.C. Motor Starters . . . across the line, reversing, and non-reversing, and in combination units.

Contactors for A.C. and D.C.



Manual Speed Regulators and Field Rheostats.

Heavy-duty, weatherproof control stations built to prevent accidental starting or stopping by operator.

Which Will You Need..

CUSTOM-BUILT OR STANDARD MOTOR CONTROL EQUIPMENT?

If your post-war reconversion plans **call for alterations or additions to your present motor control set-up, be sure to get facts and figures on the famous Monitor line before proceeding with final installation arrangements. That's because you may find that Monitor equipment can do the job better . . . at lower cost.**

This holds true regardless of the size and type motor control equipment you may require . . . standard units of the type shown at left which control a single motor, or custom-built units of the type shown below which control an entire multiple motor operation.

On *all* problems of post-war motor control
. . . see your Monitor field engineer first!

This custom-built unit controls 14 blower motors, 9 hoist motors, 7 pump motors, and four 20 H.P. motors in a large quadruple drive printing press.

Monitor
The Original
JUST PRESS A BUTTON

The Monitor Controller Company

GAY, LOMBARD & FREDERICK STS. BALTIMORE-2, MARYLAND

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Die cast enclosed MICRO SWITCHES

CONTROL THE AUTOMATIC CYCLE OF THE GILMAN HYDRAULIC TURNING MACHINE

The basic Micro Switch is a thumb-size, feather-light plastic enclosed, precision, snap-action switch, Underwriters' listed and rated at 1200 V.A. at 125 to 460 volts a-c. Capacity on d-c depends on load characteristics. Accurate repeat performance is experienced over millions of operations. Wide variety of basic switches and actuators meets requirements varying from high vibration resistance to sensitivity of operating force and motion as low as 2/1000 ounce-inches. Many types of metal housings are available.

THE hydraulic turning machine, manufactured by the Gilman Engineering Works of Janesville, Wisconsin, makes use of the long life, dependability, and accuracy of repeat performance of the Micro Switch to control its entire operating cycle automatically.

Actuation of the Micro Switch at the exact point in the movement of the hydraulically driven slide when the Elgin Head has completed a cut swings the slide away from the work. This motion actuates a second Micro Switch which controls automatic return of the slide to its starting position.

The die cast enclosure of the Micro Switch, mounted on the apron of the machine, provides rugged conduit connection, and a synthetic rubber bellows on the operating plunger protects against the entrance of coolant, oil, chips, and dirt throughout the switch life of millions of operations.

The small size of the Micro Switch and a wide selection of easy-to-use actuators and enclosures has fitted it into many special additions to machines already installed, as well as to new designs. The Micro Switch has electrical capacity, at line voltage, to control many classes of single phase motors directly, without intermediate relays or contactors, providing accurate, positive, trouble-free control.

Send for Micro Switch Catalog-Handbook No. 60 for complete details on the wide range of housings, actuators, and electrical characteristics in which Micro Switches are available. If the switch is desired for aircraft use, also ask for Handbook-Catalog No. 70.

Let's All Back the Attack
Buy EXTRA War Bonds!

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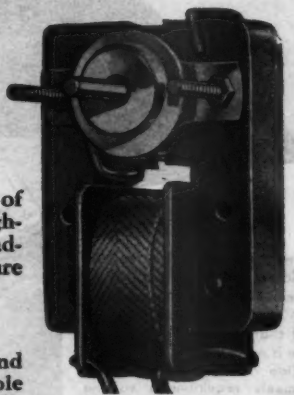
1,001 USES

Condensed Power for Years of Service

VERSATILITY and dependability were paramount when *Alliance* designed these efficient motors—*Multum in Parvo!* . . . They are ideal for operating fans, movie projectors, light home appliances, toys, switches, motion displays, control systems and many other applications . . . providing economical condensed power for years of service.

Alliance Precision

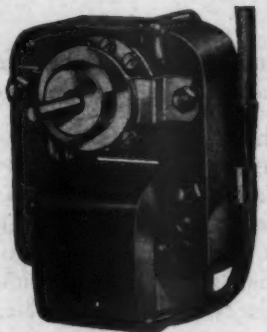
Our long established standards of precision manufacturing from highest grade materials are strictly adhered to in these models to insure long life without breakdowns.



Model "MS"—Full Size
Motor Measures
1¾" x 2 x 3⅛"

EFFICIENT

Both the new Model "K" Motor and the Model "MS" are the shaded pole induction type—the last word in efficient small motor design. They can be produced in all standard voltages and frequencies with actual measured power outputs ranging upwards to 1/100 H. P. . . Alliance motors also can be furnished, in quantity, with variations to adapt them to specific applications.



New Model "K"—Full Size
Motor Measures
2⅛" x 2⅝" x 3⅛"

DEPENDABLE

Both these models uphold the *Alliance* reputation for all 'round dependability. In the busy post-war period, there will be many "spots" where these Miniature Power Plants will fit requirements . . Write now for further information.

Remember Alliance!
—YOUR ALLY IN WAR AS IN PEACE

ALLIANCE MANUFACTURING CO.

ALLIANCE . OHIO

DO YOU MAKE:

RADIO, SOUND AND COMMUNICATIONS EQUIPMENT?

- Loud Speakers
- Headsets
- Microphones
- Hearing Aids
- Electrical Musical Instruments
- Sound-powered Telephones
- Telephone Ringers
- Voltage Regulators
- Phonograph Cutting Heads
- Phonograph Pick-ups
- Vibration Pick-ups
- Polarized Relays
- Generators
- Meters
- Magnetron Fields

AUTOMOTIVE AND AVIATION EQUIPMENT?

- Magnetos
- Tachometers
- Compasses
- Voltage Regulators
- Motors
- Speedometers
- Generators
- Magnetic Oil Filters

INSTRUMENTS?

- Ammeters
- Voltmeters
- Galvanometers
- Seismographs
- Oscillographs
- Flux Meters
- Watt-hour Meters
- Flow Meters
- Light Meters
- Cardiograph Recorders
- Vibration Pick-ups

MISCELLANEOUS PRODUCTS?

- Magnetic Separators
- Magnetic Chucks
- Magnetic Conveyors
- Magnetic Clutches
- Magnetic Damping Devices
- Arc Blow-out Magnets
- Temperature and Pressure Control Equipment
- Circuit Breakers
- Limit Switches
- Holding Magnets
- Clocks
- Toys and Novelties
- Coin Separators for Vending Equipment

IF YOU make any of the above products, it will pay you to find out how *better permanent magnets* can improve efficiency and reduce costs. Put your design, development or production problems up to The Arnold Engineering Company. Arnold engineers have been of great assistance to many manufacturers and are at your service to advise exactly what Alnico permanent magnet will solve your particular problem.

NEW! Get your copy of this valuable, up-to-the-minute manual on the design, production and application of modern Alnico permanent magnets. Write us, on your company letterhead, today.

THE ARNOLD ENGINEERING COMPANY

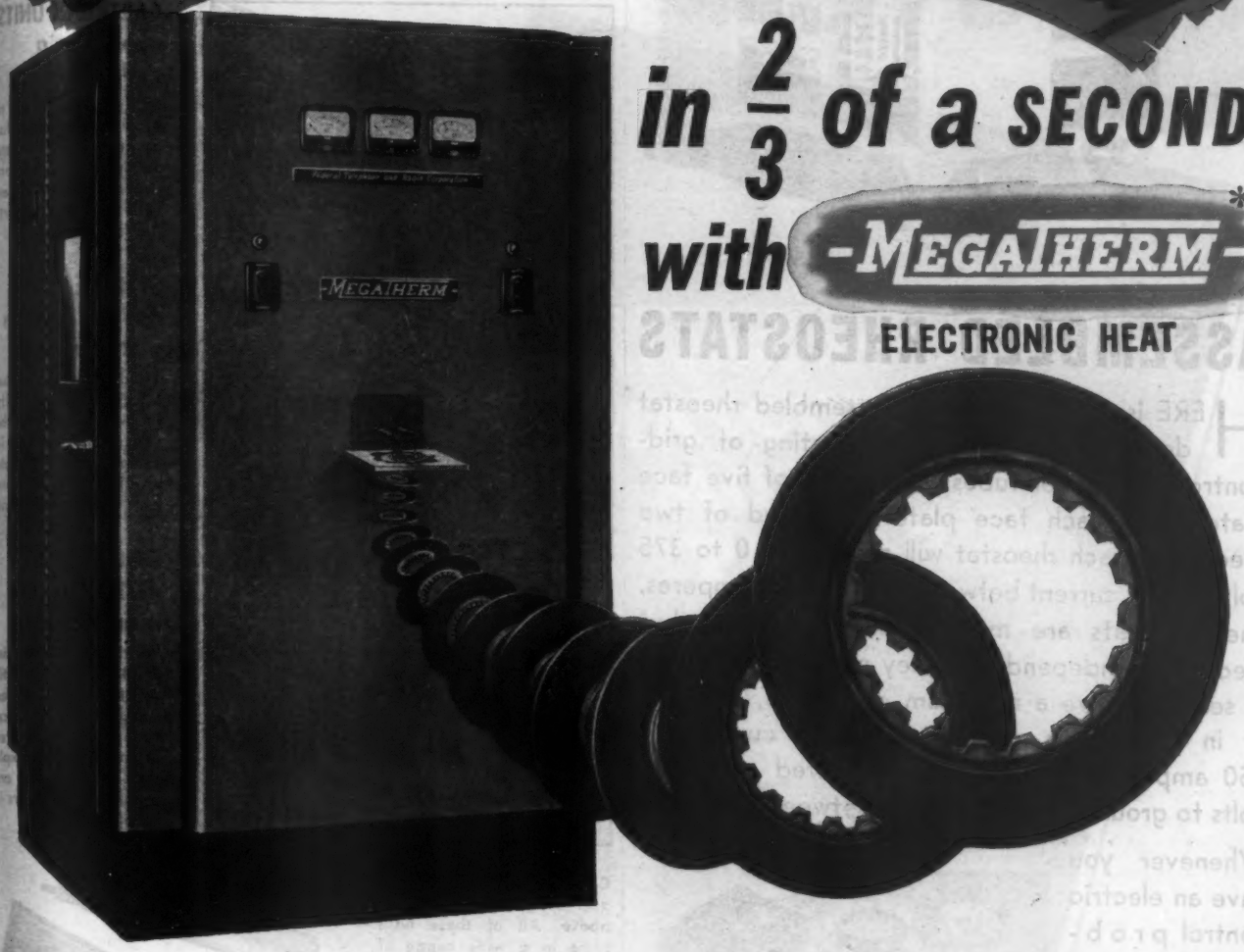
147 EAST ONTARIO STREET, CHICAGO 11, ILLINOIS

Specialists in the manufacture of ALNICO PERMANENT MAGNETS

Exact Contour Hardening

in 2/3 of a SECOND

with -MEGATHERM-* ELECTRONIC HEAT



Here's another difficult hardening job, done simply and quickly with Megatherm.

Exact contour hardening of the inner gear of these supercharger clutch discs was done in less than ⅔ of a second each.

These gears were hardened to a depth of .050", with the hardening closely following the tooth and root contour of the gear surface, without affecting the strength or ductility of the remaining metal. The unretouched photograph above tells the story.

To do this contour hardening a jig was built to support the disc so that its inner surface surrounded a two-turn induction coil, directly connected to the output terminals of the 25 kw Megatherm.

The Megatherm automatic timer limits the heat period to exactly ⅔ of a second, then operates a solenoid which trips the disc into an oil-quench bath.

Here is another example of Megatherm's adaptability to many hardening problems involving irregular and "hard-to-get-at" surfaces.

If you have a surface hardening problem . . . whether for wartime or peacetime application . . . consult Federal's Megatherm engineers for the answer or write for complete data.

FEDERAL TELEPHONE & RADIO — FTR

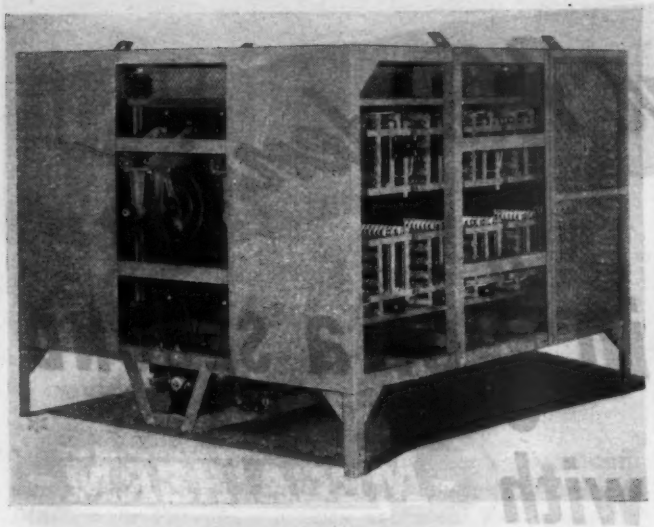
Federal Telephone and Radio Corporation

*REG. AND PAT. TRADE MARK

INDUSTRIAL ELECTRONICS DIVISION

AN IT&T ASSOCIATE

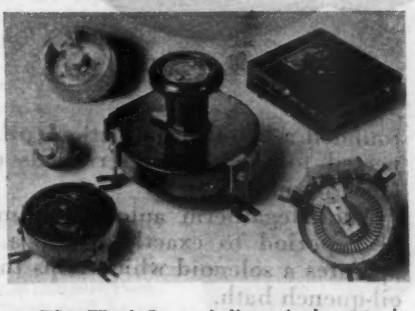
Newark 1, N. J.



ASSEMBLED RHEOSTATS

HERE is a Ward Leonard assembled rheostat designed for production testing of grid-controlled rectifier tubes. It consists of five face plates with each face plate composed of two rheostats. Each rheostat will drop from 0 to 375 volts at any current between 15 and 0.15 amperes. The rheostats are mechanically connected but electrically independent. They may be connected in series to give a maximum drop of 3,750 volts or in parallel to give a maximum current of 150 amperes. The assembly is tested at 10,000 volts to ground and 2,000 volts between rheostats.

Whenever you have an electric control problem, Ward Leonard engineers are at your service.



The Ward Leonard line of rheostats includes steel plate types, porcelain ring types and ribohm face plate types. These rheostats provide control for the minute current requirements of the laboratory and the heaviest current demands in industrial applications.

Send for rheostat bulletins of interest to you.

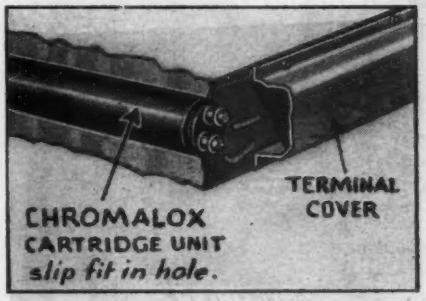
WARD LEONARD

RELAYS • RESISTORS • RHEOSTATS

Electric control (WL) *devices since 1892.*

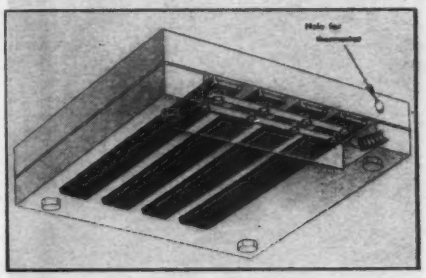
WARD LEONARD ELECTRIC COMPANY
63 SOUTH STREET, MOUNT VERNON, N. Y.

Heat machine parts– WITH CHROMALOX *Electric* HEATING UNITS



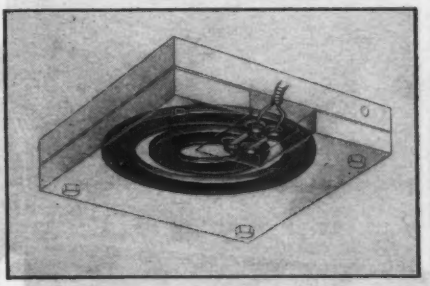
CARTRIDGE UNITS applied to a mold or platen

Drill holes of size to provide a snug fit, for as many units as are needed. A simply constructed cover, held on with screws, protects the terminals.



STRIP HEATERS applied beneath platen or plate

Weld studs to bottom of plate, for Utility Clamps, which hold the strip heaters firmly in contact with the plate insuring most economical transfer of heat.



RING UNITS nested, to heat a circular area

Weld studs to bottom of plate and with Utility Clamps hold nested units firmly in place. For moderate degree of heat use a simple ring. These units are simply strip heaters in circular form.

Cartridge unit, strip heater and ring units as used above. All of these units come in a wide range of standard lengths or sizes, and have thousands of industrial applications.

If you have a specific application, write us with rough pencil sketch of conditions. Our engineering cooperation is at your service. Chromalox Catalog mailed on request.

EDWIN L. WIEGAND CO.
7535 Thomas Blvd., Pittsburgh 8, Pa.

CHROMALOX means ELECTRIC HEAT AT ITS BEST

If it's going to take a MOTOR...

TAKE TIME TO READ THIS →

That new product you're thinking about... if it's going to take a motor, investigate what motor parts can do in reducing size, weight, or unsightly contours.

Begin by asking for your copy of the new, free R&M *Matched Motor Parts* catalog. In it you will find plenty of facts and figures to help you decide on the right power unit for the job.

Match those facts against the factors of power supply available, duty cycle expected, weight and cubic inch volume per horsepower, operating performance, speed-torque characteristics, starting torque, ventilating method, and cost.

Do that, and you'll find that there is one right combination of R&M motor parts that is just what you're looking for.

Thirty-two pages of text, illustrations, diagrams, and charts are yours for the asking. Send for your copy of the new R&M *Matched Motor Parts* catalog, today.

ROBBINS & MYERS • INC.
MOTOR DIVISION, SPRINGFIELD, OHIO
HOISTS & CRANES • MACHINE DRIVES • FANS • MOYNO PUMPS • FOUNDED 1878

OHIO
SMALL MOTORS

for General Purpose Applications

Types—Split Phase, Capacitor, Shaded Pole, and Direct Current
Speeds — 1100, 1700, 3400 RPM
Power—1/80 to 1/20 HP, depending on speed
Voltages—up to 440 A.C. and 250 D.C.
Frequencies—60, 50, and 25 cycles
Bases—Solid, Resilient or Flange
Mountings—Horizontal, Sidewall, Ceiling or Vertical, with shaft up or down
Efficiency—High for such small powers

OHIO MOTORS INCLUDE

Split-phase induction to 1/3 HP	Torque to 100 oz. ft.
Direct Current to 1 HP	Shaded Pole to 1/30 HP
Capacitor to 2 HP	Synchronous to 1/4 HP
Polyphase to 2 HP	A.C. to D.C. Motor Generators to 500 watts
Aircraft Motors	High to Low Voltage D.C. Dynamotors up to 300 watts
Shell Type to 7½ HP	

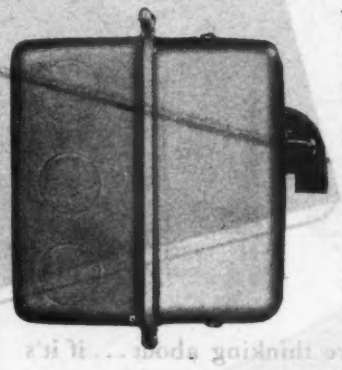
What is your problem?

THE OHIO ELECTRIC MFG. CO.
5911 Maurice Avenue Cleveland 4, Ohio

PRECISION CONTROL OF TIME INTERVALS

assured with Paragon PRESET TIMERS

2509 for surface mounting.



2509 for gang switch box or handy box mounting.

Paragon improved manually preset timers can be preset to perform a great variety of operations . . . to allow a given operation to continue for almost any pre-determined time limit . . . to close or open a circuit at the end of the preset time. Synchronous motor operated. Assures absolute accuracy of the timing cycle. Not affected by vibration or changes in ambient temperature. Supplied as standard with single pole, double throw switches and choice of 10 time ranges and 3 types of mounting . . . 2400 series for flush mounting, 2500 for surface mounting, 2900 for wall mounting.

Paragon *Chicago*
BUILDERS OF ELECTRICAL EQUIPMENT SINCE 1905

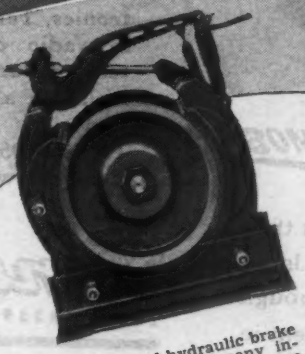
PARAGON ELECTRIC CO.
708 Old Colony Bldg. • Chicago 5, Ill.

Mr. Tops, the Paragon symbol of top-quality.

Wagner

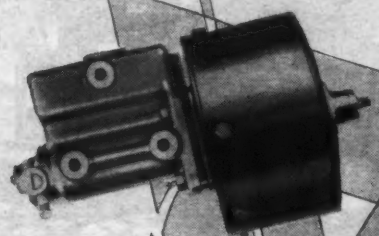
can help you solve all of your Motor, Transformer, and Braking Problems

Air-cooled transformer, typical of sizes 10-kva and smaller, which are adaptable to indoor or outdoor installations.

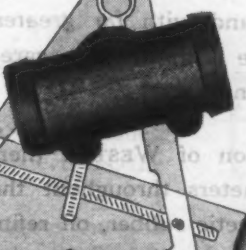


Industrial hydraulic brake—applicable to many installations where positive braking is of paramount importance.

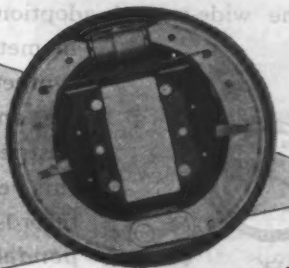
Totally-enclosed fan-cooled motor assures positive protection against destructive elements.



Air-hydraulic power cluster—converts energy contained in compressed air into hydraulic pressure.

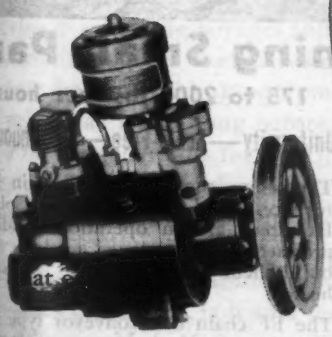


Wagner Lockheed actuating cylinder—controlled by master cylinder or other hydraulic power.



Wagner Lockheed internal hydraulic brake for application to some types of industrial machinery.

Wagner Lockheed master cylinder—can be made applicable to control of hydraulic pressure for industrial machinery.



Rotary air compressor—can be used in conjunction with hydraulic air-actuated systems or in straight-air controlled systems.

Wagner Electric Corporation

ESTABLISHED 1891

6406 Plymouth Avenue, St. Louis 14, Mo., U. S. A.

ELECTRICAL AND AUTOMOTIVE PRODUCTS

Wagner engineers can help you solve your motor, transformer, or brake problems. They invite your inquiries and will be glad to assist you.

G44-1A

MOST *Readable*

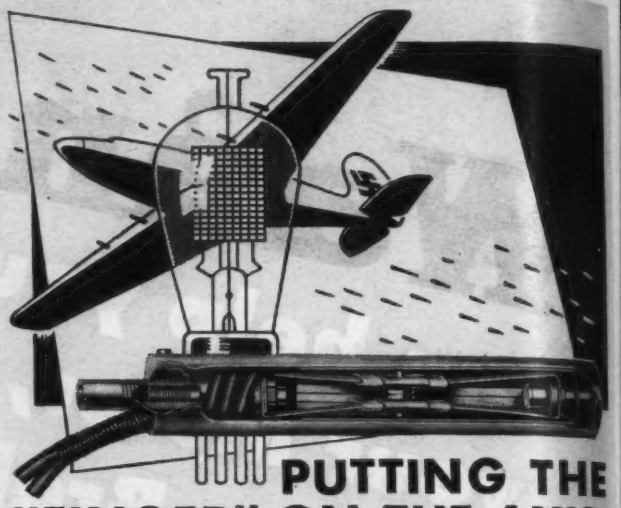
Where READABILITY COUNTS *MOST*

Wherever temperatures are critical WESTON thermometers are preferred because of their large, boldly marked dial-type scales. Even though mounted high above eye level, or on equipment in poorly illuminated areas, the scale is visible, *and readable,* without inconvenience. Thus readings are made in less time... and with *far greater accuracy*... and without the temptation to carelessness that low visibility invites.

The wide-spread adoption of WESTON thermometers throughout the synthetic rubber, oil refining, and other process industries has been due to this readability, *plus* the records for *long-time dependability* which these simple all-metal thermometers have established. Literature giving complete specifications on all models gladly furnished on request. Weston Electrical Instrument Corporation, 684 Frelinghuysen Ave., Newark 5, New Jersey.

WESTON All-Metal Temperature Gauges are available in sizes and types for most industrial needs . . . as well as in laboratory models with full scale accuracy within ½ of 1%.

WESTON



PUTTING THE "FINGER" ON THE AXIS!

Aiding in the wizardry of electronics, Fenwal THERMOSWITCHES are used in radio detection units to insure constant temperature of the crystals that select and maintain a desired frequency. The rugged construction and extra-sensitivity of Fenwal THERMOSWITCHES make them ideal equipment for war . . . and peace.

Fenwal INCORPORATED

203 PLEASANT ST., ASHLAND, MASSACHUSETTS

For Hardening Small Parts

175 to 2000 lbs. per hour

Uniformity—Scale-Free—Continuously

Products being treated in EF Chain Belt Furnaces, include:

- Sprockets
- Cap screws
- Bolts and nuts
- Gears and pinions
- Flat springs
- Coil springs
- Small forgings
- Valve springs
- Spring plates
- Tractor links
- Rivets and washers
- Wrench & tool parts
- Bearing parts —cups and cones
- Machine gun cartridge clips
- Aircraft engine parts
- Automotive parts
- Rock bits, and many other products

The above shows two EF chain belt furnaces we installed in one plant. Hundreds are in operation handling products such as listed at left. We build them for gas, oil or electrically heated.

The EF chain belt conveyor type furnace is one of the most satisfactory general purpose furnaces built for the continuous, uniform, economical production heat treatment of small and medium size products.

Send for circulars showing the chain belt and other types of EF production furnaces

The Electric Furnace Co., Salem, Ohio

Gas Fired, Oil Fired and Electric Furnaces—For Any Process, Product or Production

SATISFYING THE WORLD'S TOUGHEST CUSTOMER

Fittest of the Fleet

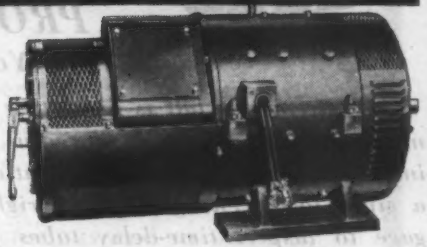
THEY'RE the Fittest of the Fleet – the volunteers who man U. S. submarines.

Relatively few men have the physical stamina, the mental alertness, the iron nerve, that admit them to the submarine service.

Because equipment must match the men, everything that goes into the making of a submarine is built to the strictest specifications on record – must pass careful inspection, endless testing. Knowledge that safety of the submariners depends upon the ability of equipment to stand up under strains of year-long voyages and shocks of battle makes Navy engineers and purchasing agents "tough customers" to satisfy.

Star began building equipment to satisfy these "tough customers" in World War I, and long before Pearl Harbor, resumed making of motors and motor generators for the U. S. Navy. While the Navy does not endorse any product the fact that Star equipment has met and exceeded U. S. Navy specifications for submarine use is positive proof of the engineering ability of this organization.

That engineering ability, developed in years of service for "the world's toughest customer", is at your service in solving peace-time motor problems. Star Electric Motor Company, 200 Bloomfield Ave., Bloomfield, New Jersey.



What's your special motor problem?

American submarines have a better chance of escaping enemy detection while running submerged because of the Star steering gear motor (above). Extremely quiet operation is achieved by advanced design, including use of a special Star internal expanding shoe brake built integral with the motor. Twelve other types of Star motors are used on U. S. submarines.

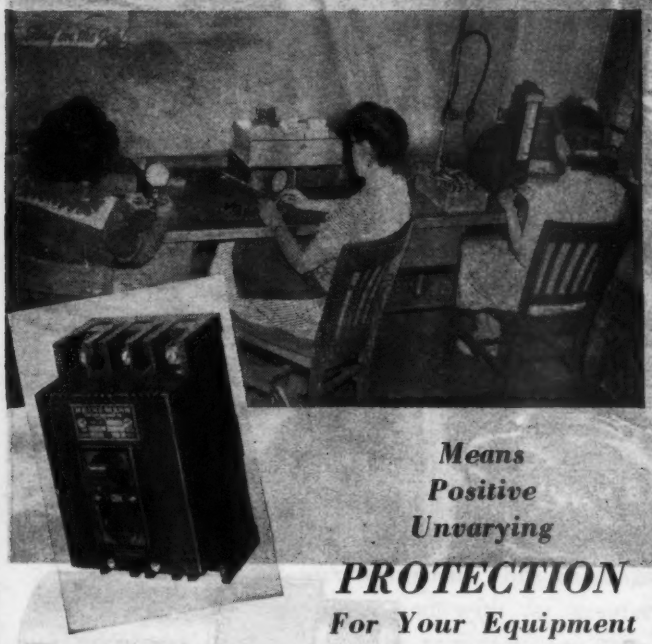
Star's Navy record is proof of our ability to handle your difficult motor problems. If a standard Star motor (⅛ to 200 H.P.) does not meet your needs Star can build one that will! We are ready to discuss your post-war plans now.

ARMY-NAVY E

STAR MOTORS

POWER PACKAGED AS YOU NEED IT

Constant and Rigid
INSPECTION
of
HEINEMANN
MAGNETIC CIRCUIT BREAKERS



Means
Positive
Unvarying
PROTECTION
For Your Equipment

The girl at the left is inspecting part of the toggle mechanism for accuracy of radius. The next girl is inspecting contact bars for amount of deflection under a given load. The girl at the right is using an air gage to inspect time-delay tubes for correct inside diameter.

You may have complete confidence in the positive operation of your HEINEMANN Circuit Breaker. Our Quality Control Department is responsible for production of parts and assemblies according to rigid specifications set up by our customers as well as our own Engineering Department.

Process Inspection on sub-assemblies and final assemblies consists of raw materials, parts, finish and workmanship inspection. The completed Circuit Breaker then passes a final test insuring a finished product worthy of the HEINEMANN label.

HEINEMANN CIRCUIT BREAKER CO.

Subsidiary of Heinemann Electric

Est. 1888

109 PLUM STREET TRENTON, N. J.

ROD BABBITTING
ANOTHER PLANT CONTROLLED OPERATING *in all* WISCONSIN *Air-Cooled* ENGINES

There's more to babbitting connecting rod bearings than simply applying the metal. Not only must the work be expertly done, but it is important that frequent detailed chemical analyses be made of materials in order to provide a dependable safeguard against inferior quality bearing metal, and to assure constant uniformity.

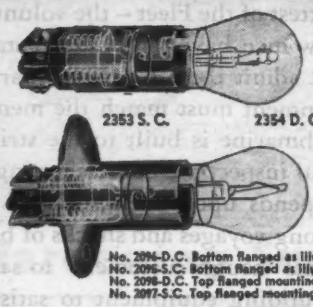
Wisconsin Engine connecting rod bearings are babbitted in our own plant, under our own complete control. A careful check is maintained to make sure that the metal is always what it should be and that it is applied the way it should be. This helps to make a better engine . . . designed to give better service on your equipment.

Most H.P. per pound

WISCONSIN MOTOR Corporation
MILWAUKEE 14, WISCONSIN, U. S. A.
World's Largest Builders of Heavy-Duty Air-Cooled Engines

SOCKETS
ENGINEERED BY *Cole-Hersee*
FOR NEW TYPE OF NEON AND ARGON GLOW LAMPS

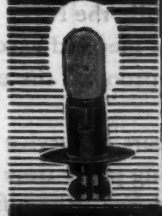
SINGLE CONTACT SOCKETS



2353 S. C. 2354 D. C.

No. 2096-D.C. Bottom flanged as illus.
No. 2096-S.C. Bottom flanged as illus.
No. 2098-D.C. Top flanged mounting
No. 2097-S.C. Top flanged mounting

DOUBLE CONTACT SOCKETS



For Miniature Base Single Contact Only

SOCKET	SOCKET HOLDER
No. 2501 Diameter .425 in.	⅜ in. Long Brass, Nickel Plated
No. 2502 Diameter .425 in. 17/32" Long	Sleeve No. 2902 Socket and Sleeve Both Brass, Nickel Plated
No. 2503 Diameter .425 in. 21/32" Long	Holder No. 2902

FOR THE FOLLOWING NUMBERS

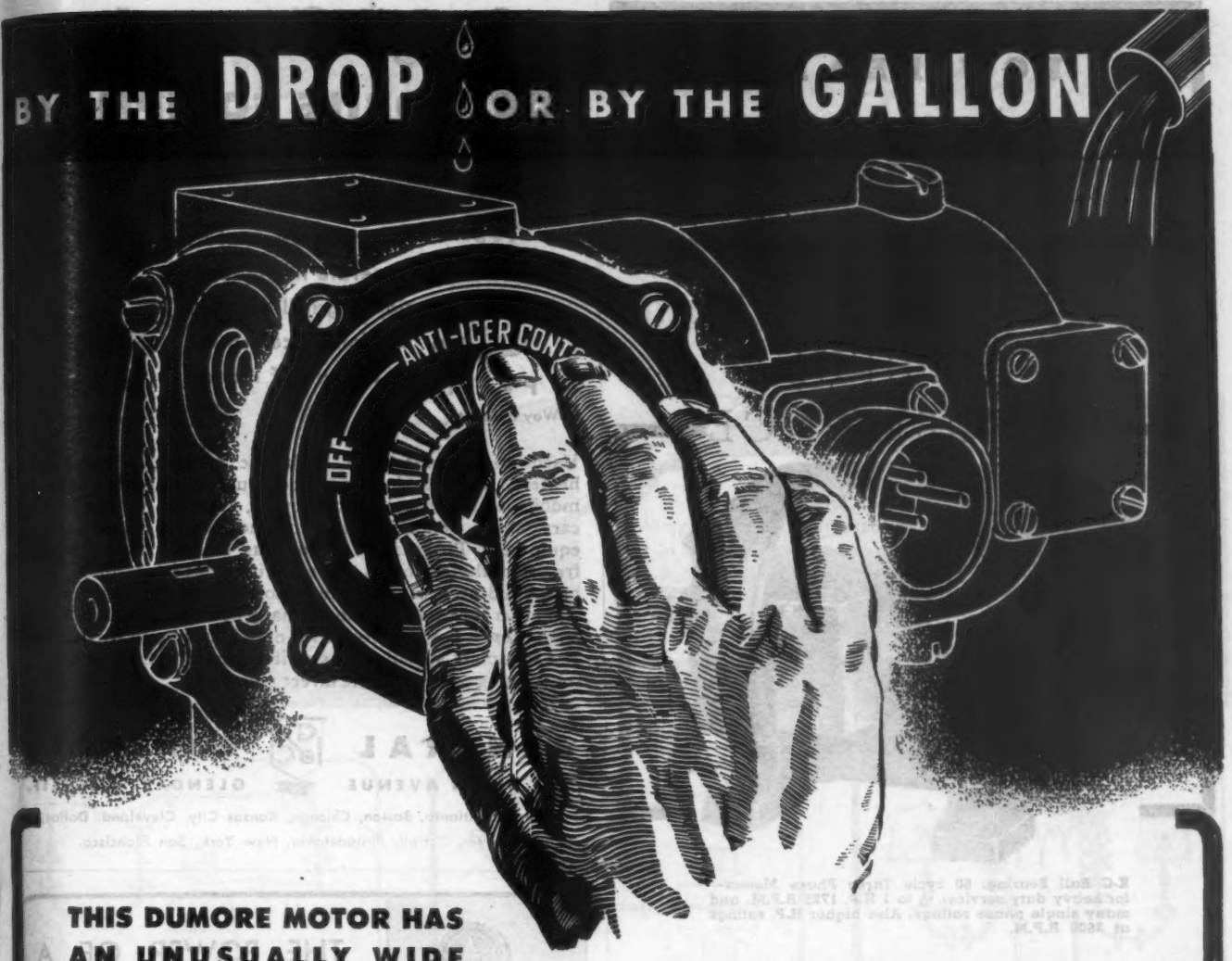
NE-42
NE-36
NE-32
NE-26
NE-48
NE-15
NE-21
NE-17
AR-2
AR-4

Heavy Screw Terminals permit easy attachment of resistors and wire leads

If you have a problem in switch or socket application bring it to Cole-Hersee for prompt action.

Cole-Hersee Company
54 OLD COLONY AVE. BOSTON 27, MASS

BY THE DROP OR BY THE GALLON



THIS DUMORE MOTOR HAS AN UNUSUALLY WIDE RANGE OF OPERATION!

Its job right now is to drive a metering pump, delivering anti-icing fluid to airplane propeller blades. Here are some of the unusual conditions it must meet to satisfy the requirements of its vital function: Its speed is controlled by a rheostat to provide a flow of from two and one-half to thirty gallons per hour!

When the minimum flow is required the pilot turns the knob from "off" to "low" and the motor must *start* and *run,* on even the *minimum current.* At whatever setting of the rheostat, the motor speed is expected to be relatively stable, unaffected by such external conditions as temperatures up to 160° F. or down to 65° below zero.

This motor, and the other thirty-odd Dumore Aeromotors, now aiding in various ways to bring a victorious end to the war, will one day supply the power for many varied motor driven devices now being planned.

Engineers and manufacturers — learn *now* the many advantages in planning your post-war products around the distinctive features of Dumore motors, for greater service, sales appeal, profit. Write today for interesting descriptive literature. Address The Dumore Company, Motor Division, Dept. MM36, Racine, Wisconsin.

FOR *Extra* POWER HOURS

"MOTOR-PLAN" YOUR POST-WAR PRODUCT, NOW!

DUMORE

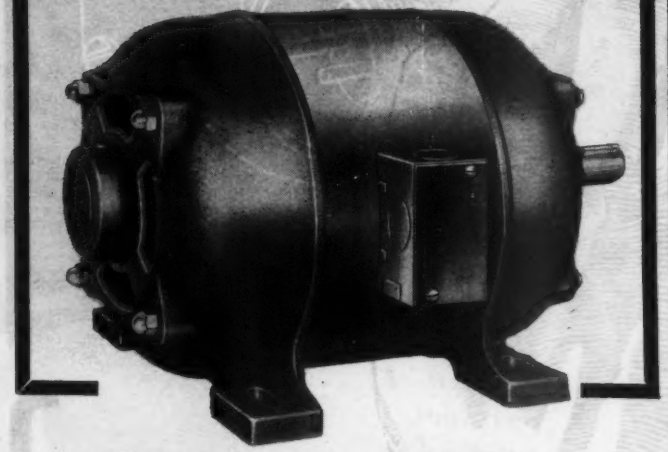
HEADQUARTERS FOR FRACTIONAL HORSEPOWER MOTORS

POWERED BY

K-C MOTORS

MEANS

POWERED FOR FAITHFUL PERFORMANCE



K-C Ball Bearing, 60 cycle Three Phase Motors—for heavy duty service; ½ to 1 H.P. 1725 R.P.M. and many single phase ratings. Also higher H.P. ratings at 3600 R.P.M.

• Full utilization of motor-driven equipment in order to meet production demands calls not only for machines capable of sustained performance but also for motors that are fully equal to the task of handling the speeds, loads and service conditions involved.

In the unprecedented rush for adequate equipment, motors must be selected on faith in their performance ability. The fact that K-C Motors have won recognition and acceptance because of performance excellency has greatly simplified the problem of small motor selection by design engineers. K-C Motors can be specified on faith.

K-C

KINGSTON-CONLEY ELECTRIC COMPANY

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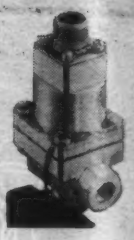
hi-g* Controls FOR MOBILE EQUIPMENT

PV-11
3-Way Magnetic

General Controls' PV Series portable electro-magnetic valves *operate in any position regardless of vibration, acceleration, or change of motion.



PV-1
Two-Wire

Used on machine tools, hydraulic presses, gasoline-fired heaters, diesel and internal combustion engines; also on mobile equipment such as: buses, tractors, trucks, tanks, cars, ships, boats, aircraft, locomotives, or other railway equipment. They handle air, oil, gas, steam, sulphur dioxide, freon, methyl chloride, water, brine, anti-icing fluids, alcohols, fluid greases, gasoline, gasoline vapor or vapor mixes, and other fluids. Available normally open or closed, in 2-way, 3-way, or 4-way control (with or without neutral position). For complete specifications write nearest branch or agency for Catalog 52B. Or write direct to

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801 ALLEN AVENUE GLENDALE 1, CALIF.

Branches: Atlanta, Boston, Chicago, Kansas City, Cleveland, Dallas, Denver, Detroit, Philadelphia, New York, San Francisco.

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Manufacturers of Emblems and Plaques for over Fifty Years

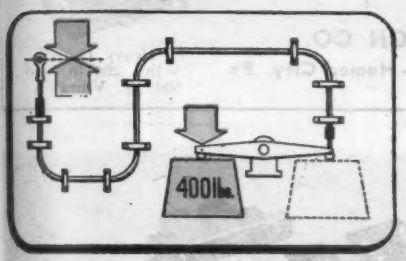
To learn how a name plate can help your product, send for your copy of "Name Plates by Robbins".

Dependable *all around duty assured with* Simmonds Push-Pull Controls

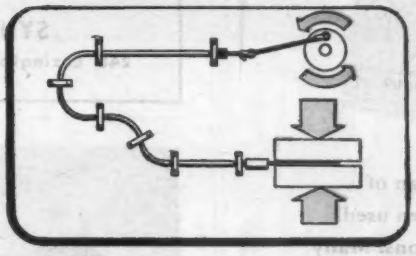
Read how these other tests, conducted to AAF specifications, show how Simmonds products more than qualify for EXTRA DUTY as well as NORMAL DUTY operations.

FIRST TO CARRY THE YELLOW DOT

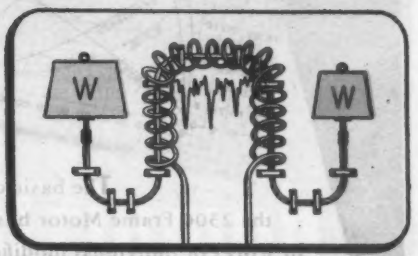
of Army Air Force Winterization acceptance for operation in extreme temperatures is the Simmonds-Corsey Push-Pull Control. Comprehensive tests with temperatures as low as minus 72°F. and as high as 160°F. prove efficient operation under wide variety of conditions.



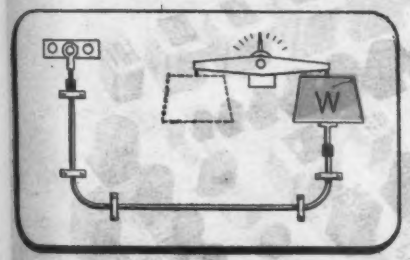
STATIC STRENGTH: *In this test Simmonds push-pull control successfully withstands tensile and compressive forces of 400 lbs. Credit simplification of design, improved linkage.*



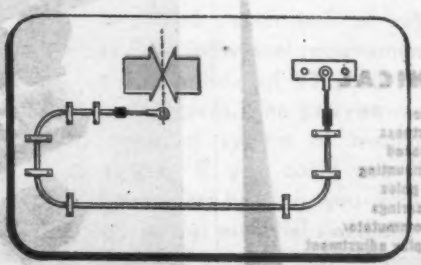
ENDURANCE: *Cycled 30,000 times under stress, as illustrated, Simmonds controls are not affected in any way, and can be expected to outlast the life of unit served.*



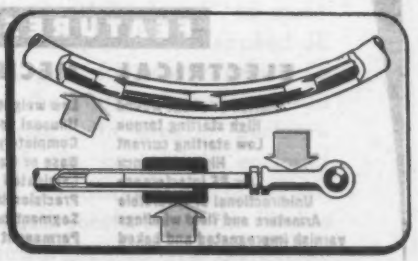
EFFICIENCY: *Input-output ratio of control is measured at various temperatures in insulated chamber. Result: average efficiencies are twice the AAF requirements.*



PRECISION CONTROL: *Motion between tension and compression is negligible. Before endurance test: average—.046"; after—.082". Simmonds are precision-built controls.*



DEFORMATION: *AAF specifications call for loads ranging from 10 to 50 lbs. Allowable average deformation is .140". Simmonds controls average only .083".*



CORROSION: *Simmonds controls meet AAF specifications for corrosion resistance with standard cadmium plated or anodized surfaces. Tube ends are rubber sealed.*

INQUIRIES concerning War Contracts or Post-War problems involving push-pull control equipment are invited. Our service engineers will furnish you gladly with analyses and recommendations. Telephone or write to your nearest Simmonds office.

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Automatic Engine Controls — Push-Pull Controls — Spark Plugs
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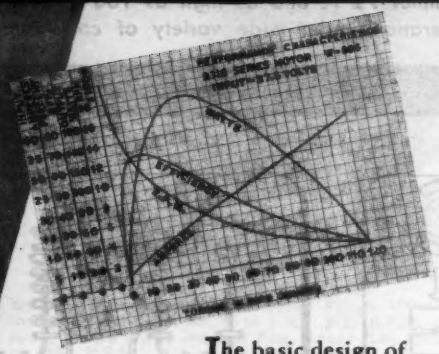
MOTOR DATA
No. 126

EICOR

2300 FRAME MOTOR
1/5 HP at 3800 RPM



The basic design of the 2300 Frame Motor has been used in scores of individual modifications. Many of these designs are complete and available—others for new equipment can readily be developed.

FEATURES

ELECTRICAL	MECHANICAL
Series or shunt wound	Low weight factor
High starting torque	Unusual compactness
Low starting current	Completely enclosed
High efficiency	Base or flange mounting
Low RF interference	Laminated field poles
Unidirectional or reversible	Precision ball bearings
Armature and field windings varnish impregnated and baked	Segment-built commutator
	Permanent end play adjustment

2300 FRAME MOTORS		2318 Series	2310 Shunt
Watts Output, Int.	(max.)	160	50
Torque at 6000 RPM	(in. oz.)	40	10
Torque at 3800 RPM	(in. oz.)	57	—
Lock Torque	(in. oz.)	120	14
Volts Input	(min.)	5	5
Volts Input	(max.)	110	28
Temperature Rise	(int.)	50°C	50°C
Diameter		2 5/16"	2 5/16"
Length less shaft		4 5/32"	2 3/4"
Shaft Dia.	(max.)	.312"	.312"
Weight	(lbs.)	2.4	1.5

EICOR INC. 1501 W. Congress St., Chicago, U. S. A.
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Plastic Presses—
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and a host of others

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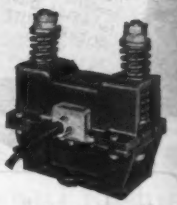
We will be glad to engineer them . . . to your problems — write —



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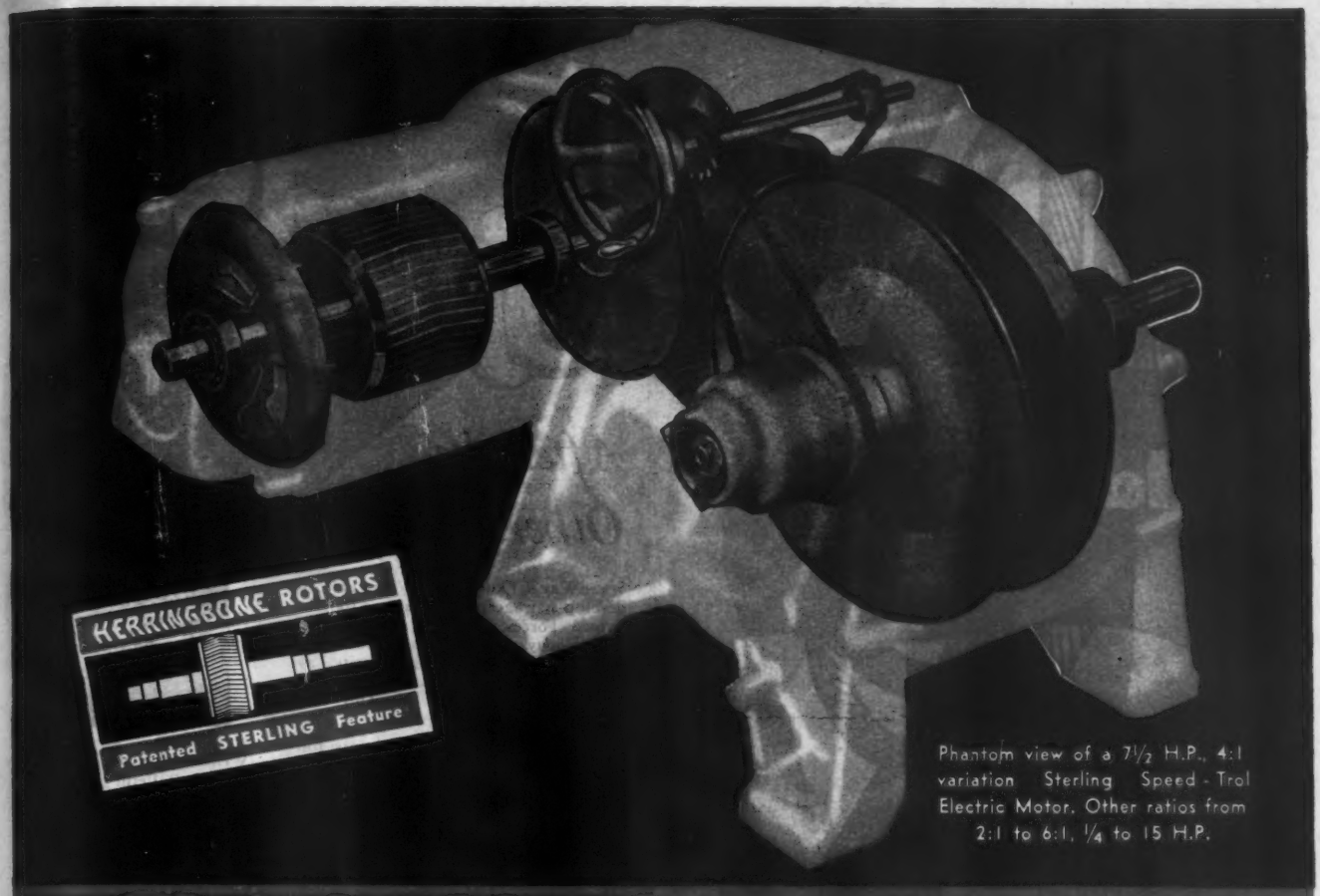

Phantom view of a 7½ H.P., 4:1 variation Sterling Speed-Trol Electric Motor. Other ratios from 2:1 to 6:1, ¼ to 15 H.P.

The Inside Story of an Engineering Triumph

The Heart of the Machine

STERLING SPEEDTROL
A revolutionary design of infinite variable speed, varying from 2:1 to 6:1, ¼ to 15 H.P.

MACHINE designers wanted a compact, self-contained power unit of variable speed "tailored" to meet all their individual requirements. Sterling engineers applied all the know-how of 43 years in fine, precision motor-making to the problem. The **proven** result is the Sterling Speed-Trol—an improved system of machine drive with greater perform-ability. If you could see through the completely enclosed Speed-Trol housing, you would see practical design; sound engineering; essential simplicity; rugged construction; the "inside story" of a motor that will complement the machines you design.

Engineering data for specific applications on request.

STERLING ELECTRIC MOTORS, INC.
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STERLING ELECTRIC MOTORS

for Greater Perform-ability

. . . for electrical applications

Callite's special wires have already proved their value in electronic equipment. Kulgrid", a Callite development, has a great post-war future in household and industrial appliances for connecting wires from terminals to heater elements.

Callite research developed "Kulgrid" to meet the need for a wire that has high heat and electrical conductivity plus strength and resistance to oxidation at high temperatures. "Kulgrid" consists of a copper core, over which is bonded a sleeve of nickel. It has 70% of copper's conductivity . 100% of nickel's resistance to oxidation and corrosion. It can stand up under high temperatures, fatigue, and corrosive conditions, infinitely better than copper without failing.

Rx FOR R*-DAY
(*Reconversion)

"Clad" Wires can add a plus to your post-war products. Talk over your plans with a C-T engineer soon.

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SpeedWay's "know how" was able to develop new gearmotor designs for the Armed Forces that did the required job. Today, expanded needs for these motors take SpeedWay's capacity, as well as the capacities of other large motor manufacturers, *working to SpeedWay Specifications.*

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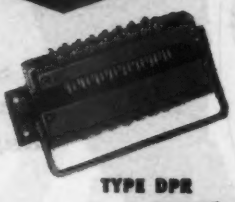
LOOK TO CANNON 'DP' CONNECTORS IN 1945

HERE ARE A FEW OF THE 'DP' CONNECTORS AVAILABLE *NOW* AND MANY NEW DESIGNS ARE COMING

NEW applications of the exclusive Cannon Electric "DP" series of connectors have recently been extended from rack equipment in radio assembly to such uses as special centralized aircraft control on through to signal relay equipment.



TYPE DPR

TYPE DP-30

TYPE DP-D

TYPE DP-P10

Several new "DP" connectors of strikingly new design will be released in 1945—testimony to the progressive engineering Cannon Electric incorporates into its products. Since Cannon Electric pioneered the aircraft electrical connector in 1932, this development process has gone steadily onward. Cannon is prepared to meet the demands of postwar electrical equipment.

Cannon Type DP Connectors cover a variety of rack, panel and bail-type fittings, carrying from eight to 135 circuits with amperage range from 10, 15, 30 and 40 in many varied arrangements, including coaxial contacts. All these and many other high quality electrical connectors are Cannon designed and manufactured.

For detailed engineering data on Type DP Connectors refer to the Cannon DP Bulletin. Write to Department A-106, Cannon Electric Development Company, 3209 Humboldt Street, Los Angeles 31, California.

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GALVANOMETERS . . . D'Arsonval Portable in either pointer or mirror types for laboratory or production testing service. Movements of either type available for use as built in component of other instruments.

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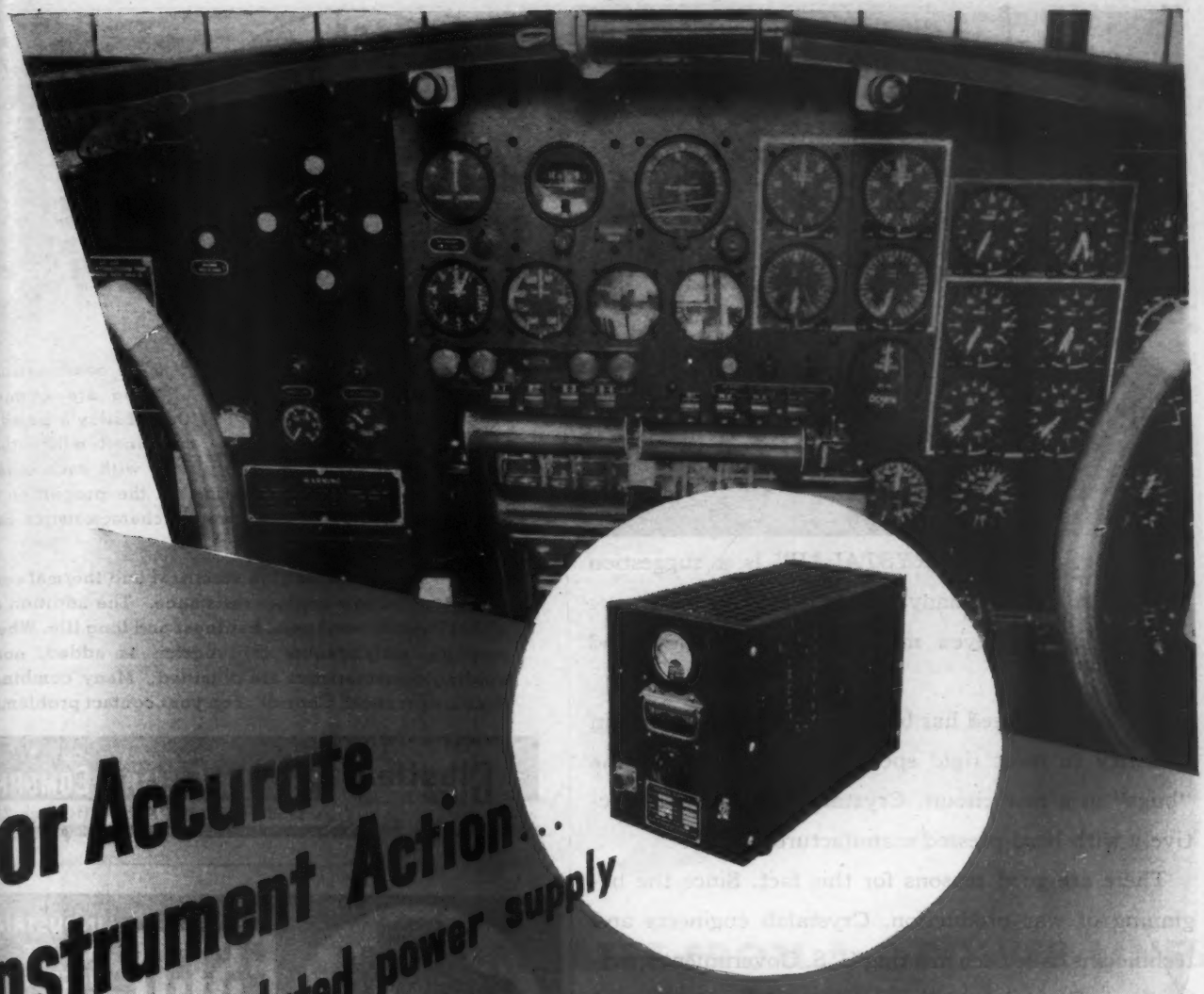

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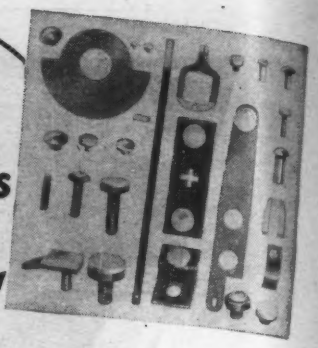
ELECTRICAL CONTACTS
with
PRE-DETERMINED CHARACTERISTICS
through
POWDER METALLURGY



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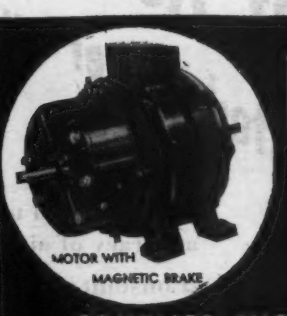

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"MOTOR-DRIVE IS MORE THAN POWER"

Above: Controls of this 125-ton Beloit Crankpin Turning Lathe are grouped within easy reach of operator.

As shown at right, Reliance V★S Drive is also available with a "packaged" control unit, to provide smooth speed changes over wide ranges.

Above: The built-in Reliance V★S Adjustable-speed Drive furnishes controlled power for all functions from A-c. circuit.

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With All Operations Electrically Controlled Through Reliance V★S Drive

In doing its job of machining the huge crankshafts for Diesel Engines, this 125-ton Beloit Crankpin Turning Lathe combines an exceptionally high rate of production with precision operation. This is due in no small measure to the use of Reliance V★S Drive.

All operations—starting, stopping, jogging, reversing, speed adjustments—are electrically controlled, using the plant's A-c. lines. All controls are within convenient reach of the operator. Both design and operation of the machine are greatly simplified.

This is but one example of the way in which, with Reliance V★S Adjustable-speed Drive, it is possible to centralize and simplify control of complicated production machines and operations. It is something you are likely to find worth talking over with a Reliance Application Engineer. Or write us at Cleveland for more information if that is more convenient.

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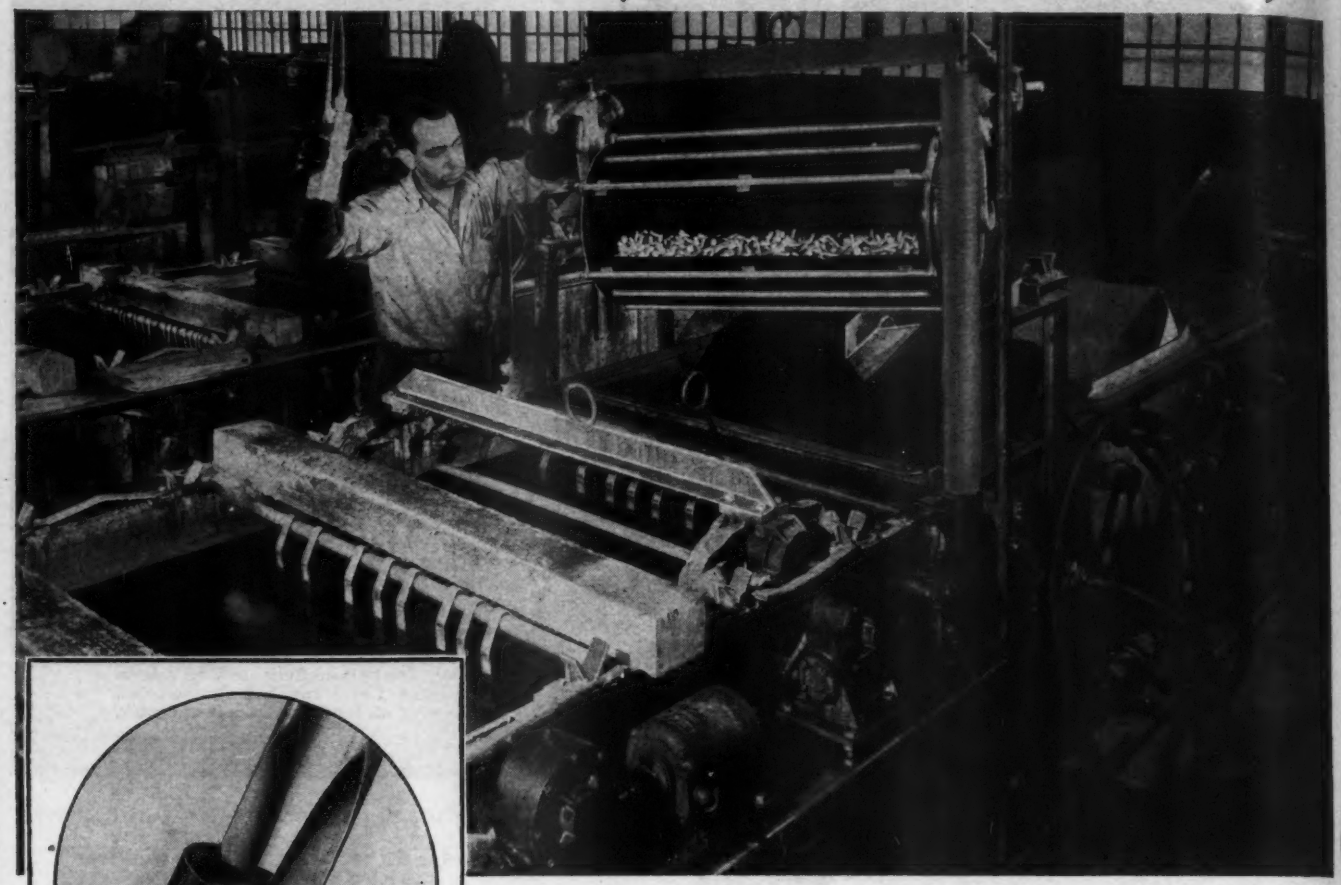
Making strong the things that make America strong



A large percentage of Phillips Screws are required in plated finishes. This work is done at RB&W in a new, modern plating plant equipped with the latest machinery and controls. Illustration shows a section of this plant, which will handle cadmium plating, bright zinc plating, Parkerizing, etc.

IDENTIFY IT!
Center corners of Phillips Recess are rounded . . .
NOT square.
Bottom of Phillips Recess is nearly flat . . .
NOT tapered to a sharp point. . .

RB&W

manufacturer of machine screws, sheet metal screws and stove bolts with the Phillips Recessed Head.

NEW SPEED WITH PHILLIPS SCREWS

from the oldest name

IN AUTOMATIC COLD-HEADING

The Phillips Recessed Head Screw is a scientifically-designed product that calls for precision manufacturing. Potentially, it offers a tremendous opportunity for time-saving; practically, that opportunity is fully realized only when the finished product has the accuracy and strength that result from careful selection of raw materials, processing to narrow tolerances, scrupulous inspection.

From RB&W you can depend upon that accuracy and strength. RB&W is the screw manufacturer with the longest experience in automatic cold-upsetting — and the Phillips Screw is a cold-upset product. This experience, together with the finest of modern equipment, means that the "RB&W-Phillips" screw can be counted on for accurate dimensions and maximum strength. It is driven faster . . . will hold tighter.

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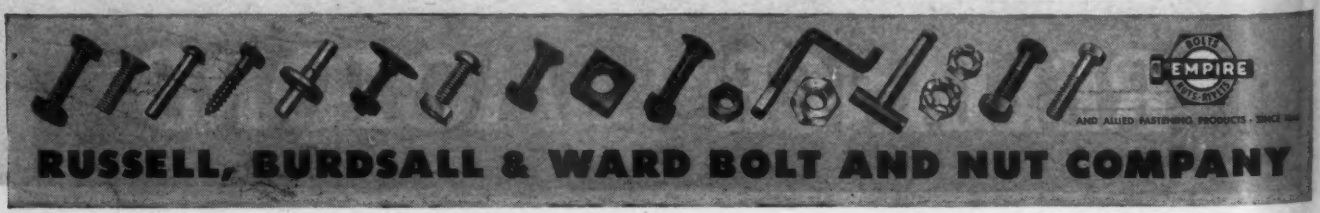
Russell, Burdsall & Ward Bolt and Nut Company. Factories at Port Chester, N.Y.; Rock Falls, Ill.; Coraopolis, Pa. Sales offices at Philadelphia, Chicago, Detroit, Chattanooga, Los Angeles, Portland, Seattle.



Today, chemicals and explosives, delicate instruments, highly polished parts and other materials and equipment susceptible to damage by jolting and jarring, are riding safely on casters.

Responsible for extending the usage of "castered mobility", is Bassick's "Floating Hub" Caster, the unique construction that smoothes out the ride, absorbing the bumps, keeping the load on even keel.

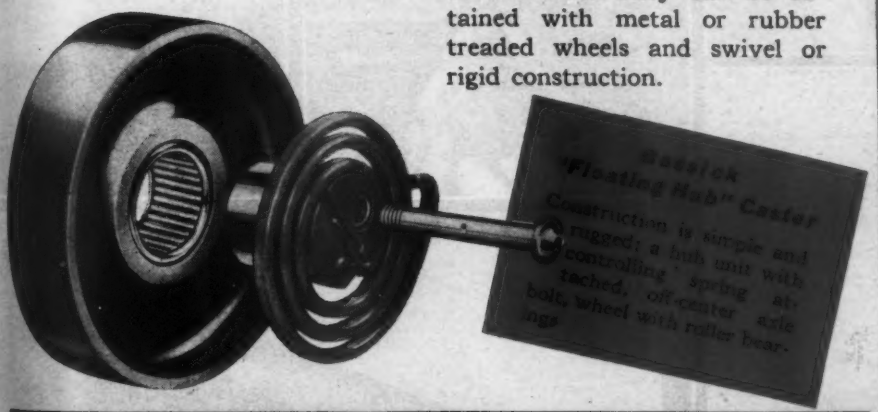
The load is carried off-center of the hub, controlled and cushioned by a shock-absorbing spring. The result is a "smoothed-out" ride — just like the one your automobile gives you.

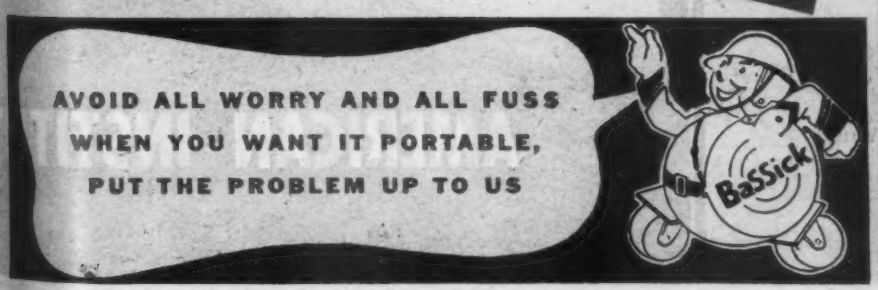
Less Maintenance — for Trucks and Floors

In addition to protecting the load, the "Floating Hub" Caster saves wear and tear on the truck, dollie or whatever structure it is used on. Floors are protected, too, because the wheel stays in contact with the floor, with no bouncing of heavy loads.

Other advantages include: *easier rolling* — the caster climbs up and over obstructions with little effort, thus speeding materials handling... *less noise* — no bumping on the floor, no jolting or shaking of the load... longer *caster life* — less abuse means longer use.

"Floating Hub" Casters are available in several sizes with operating load range from 50 lbs. to 1000 lbs. They can be obtained with metal or rubber treaded wheels and swivel or rigid construction.


Bassick
"Floating Hub" Caster
Construction is simple and rugged; a hub unit with controlling spring attached, off-center axle bolt, wheel with roller bearings



SIZES AND TYPES OF CASTERS FOR EVERYTHING THAT SHOULD BE EASY TO MOVE

A few of the many sizes and types of casters described in Bassick's new, sectionalized catalog are shown below. For more detailed information such as load capacities, mountings, construction specifications etc.... send for a copy of Catalog 122.

Threaded male or female pipe sockets in several sizes of casters are available for easy application to pipe legs. Pipe sizes from ¾ of an inch to 2 inches.

For direct application to angle iron legs, Bassick offers angle stem casters in series "68", "69", and "71". The stems are so designed that separate right and left hand types are not needed. Wheel diameters from 2½ to 8 inches.

Bassick Casters with threaded stems are available in a number of sizes and types from the light duty series "69" casters to the heavy duty series "H99"

Bassick

MAKING MORE KINDS OF CASTERS ... MAKING CASTERS DO MORE

THE BASSICK COMPANY
BRIDGEPORT 2, CONN
Division of Stewart-Warner Corp., Chicago, Ill.
Canadian Factory: Stewart-Warner Alemite Corporation of Canada, Ltd., Belleville, Ont.

Where Permanence and Safet

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TECHNICAL DATA published regularly in FASTENERS, free to operating and engineering men. Write today.
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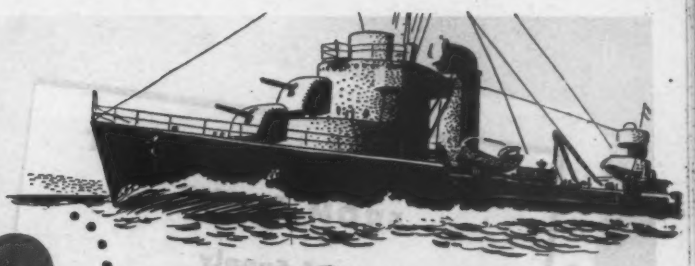
are *"musts"*—



FASTENERS

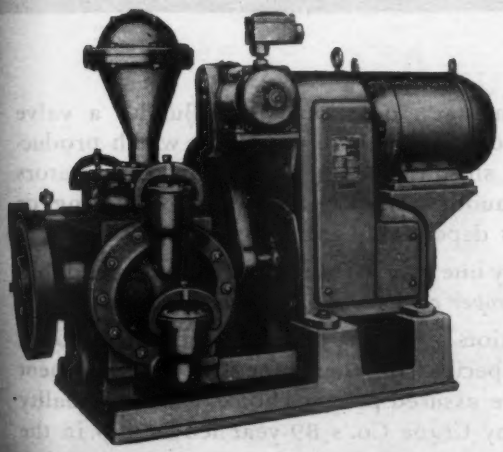
BOLTS NUTS SCREWS RIVETS

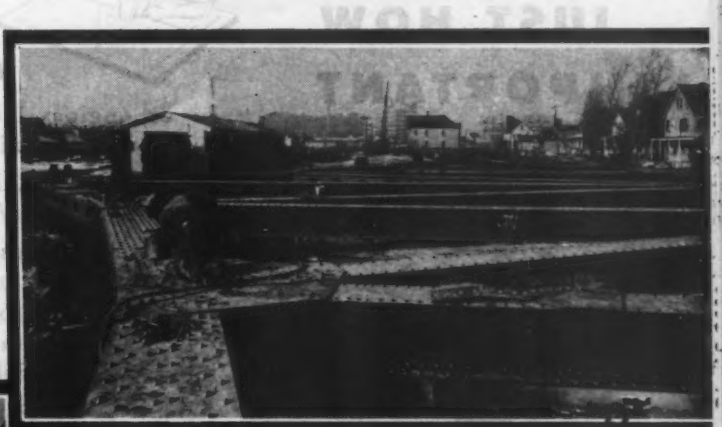
PROVIDE MAXIMUM DURABILITY AND SECURITY AT LOW COST

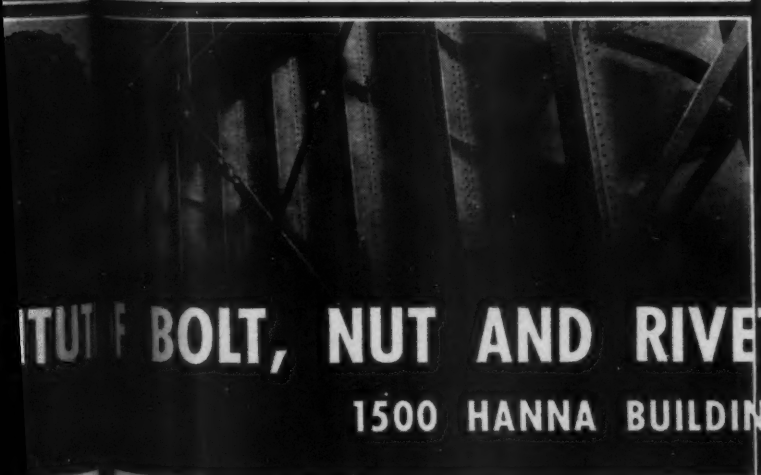
From the tiny screws in precision instruments to huge rivets and bolts in heavy machines and structures, *fasteners* serve engineering designers and manufacturers economically and dependably.

Through continuous research and development, the manufacturers of these headed and threaded fasteners have done much to make their products easier to use and better suited to the service requirements. Among recent improvements are: higher strengths, greater dimensional accuracy, closer fits, effective protective coatings, extensive use of alloy and other materials and heat treatments. Made by mass-production methods, they are available in large quantities and at low cost.

FOR THE SECURITY OF YOUR PRODUCTS, BUILD WITH FASTENERS!







ITUTE BOLT, NUT AND RIVET MANUFACTURERS

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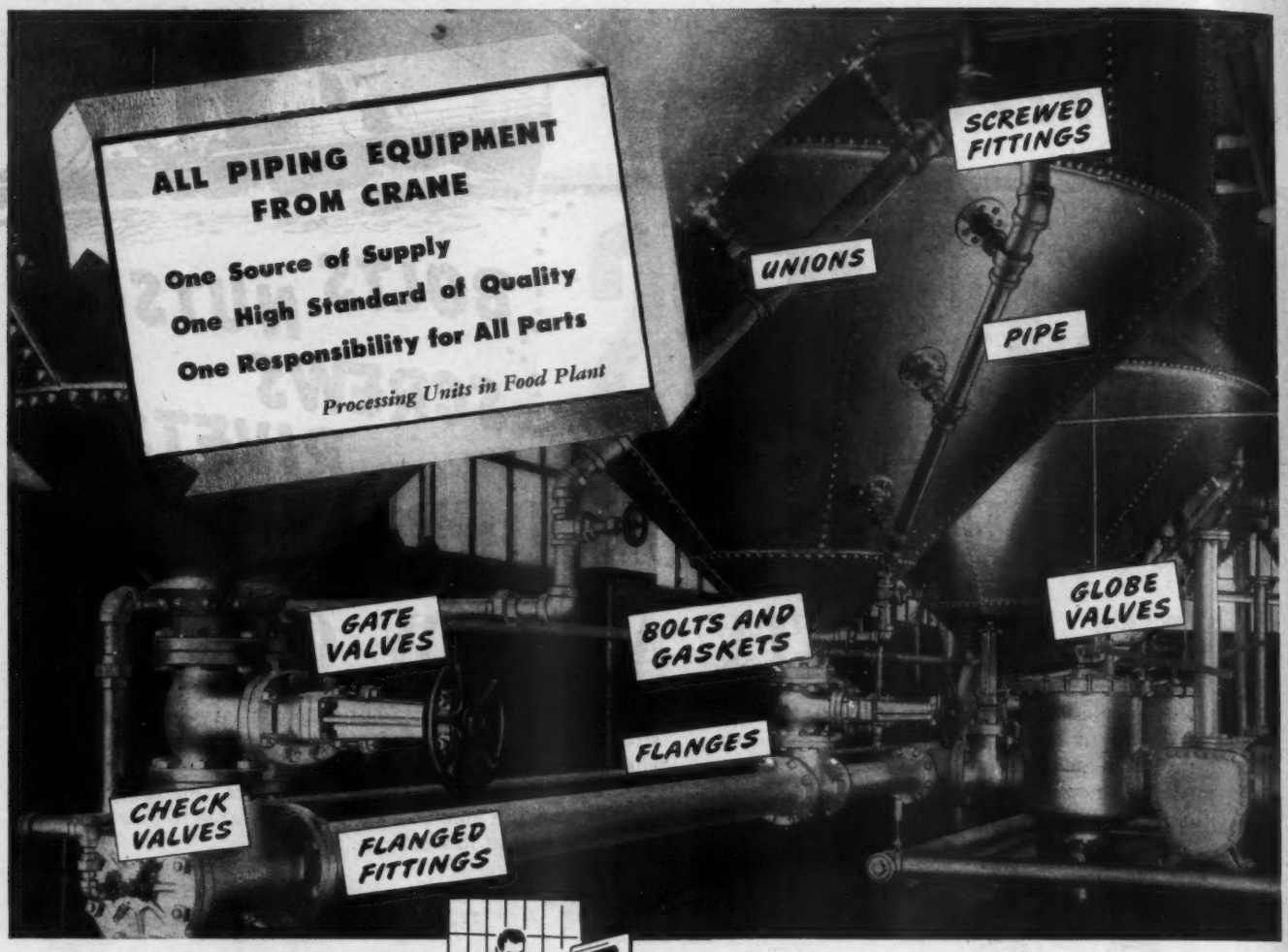


JUST HOW IMPORTANT IS THE PIPING?

An elementary question, sure! But let a valve fail on one of these units and watch production slow down—perhaps stop. Evaporators or engines, lathes or laundry machines—any unit handling or operated by fluids is only as dependable as its piping equipment.

In your designs, there's only one way to insure maximum dependability in piping—*specifying the proper equipment of adequate quality.*

The world's greatest selection of valves, fittings, piping accessories and pipe is yours when you specify from the Crane line. In equipment for every application, you are assured proper choice, with the quality of each single item backed by Crane Co.'s 89-year leadership in the piping materials field.

One source of supply—one responsibility for all piping materials—one high standard of quality. You can measure these advantages in time savings and simplified procedures from drafting to product assembly. In product showrooms, the name Crane adds sales appeal and buyer confidence.

If the answer to any piping equipment problem—on current or future designs—is not in your Crane Catalog, Crane engineers will gladly help you find it.

Crane Co., General Offices: 836 S. Michigan Ave., Chicago 5, Ill.
Branches and Wholesalers Serving All Industrial Areas.

CRANE

VALVES • FITTINGS • PIPE
PLUMBING • HEATING • PUMPS

Full Rated Capacity —but *Half the Size!*

With the new Cleveland Speedaire Worm Gear Unit it is possible to obtain an operating capacity equal to that of a standard worm gear unit having approximately double the frame size.

Speedaire—the *new* Fan-Cooled Unit—continually removes heat by means of a high-velocity air stream scouring the outer surfaces of the oil reservoir. Because Speedaire stays cool, it will give More Horsepower per Dollar.

You can install this modern, right-angle Drive Unit on many applications where you have used other types heretofore. Profit by Cleveland's latest development. Send for the Speedaire Catalog today.

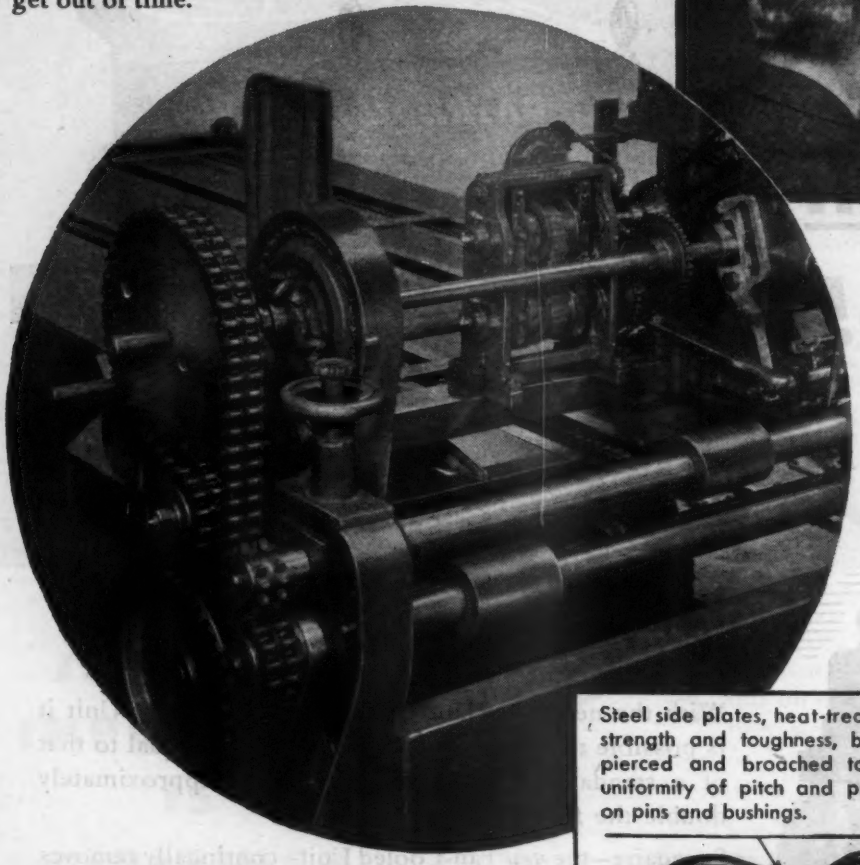
The Cleveland Worm & Gear Company, 3279 East 80th Street, Cleveland 4, Ohio.

Affiliate: The Farval Corporation, Centralized Systems of Lubrication
In Canada: PEACOCK BROTHERS LIMITED

Cleveland
SPEEDAIRE *Worm Gear Reduction Units*
FAN COOLED

IT TAKES A "FIRM GRIP" FOR ACCURATE TIMING

① WHEN YOU NEED SPLIT-SECOND TIMING, you'll find that Rex Roller chain belts can deliver the goods. For, the way these smooth-running chains take a firm grip on sprocket teeth, it's impossible for a machine to "get out of time."

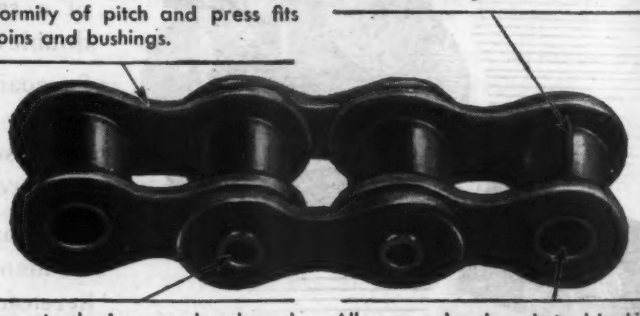


② TIMING IS IMPORTANT on this taping machine. It tapes boxes as they are formed from corrugated board. All functions . . . conveying, transmitting power and timing of various operations must be perfectly co-ordinated. That's why Rex Roller chain belts are used. They don't slip . . . wear is negligible.

③ HERE'S WHY THEY'RE SO GOOD! Take a good look at these links. Rex Roller chain belt is a product of the highest quality workmanship and materials. Note how accurately the link is formed. For high speed drives, compactness, quiet operation and high efficiency, this chain is "tops." Made in manufacturer's standard sizes, you can get it in single, double or multiple strands for every type of service.

Steel side plates, heat-treated for strength and toughness, blanked, pierced and broached to insure uniformity of pitch and press fits on pins and bushings.

Alloy steel roller heat-treated for extreme toughness and resistance to wear, then ground to size.



Alloy steel pin, case hardened, ground for accuracy, superior bearing surface. Longer pitch chains furnished with cotter construction.

Alloy, case hardened steel bushing ground for accuracy and press fits in side bars.

* * *

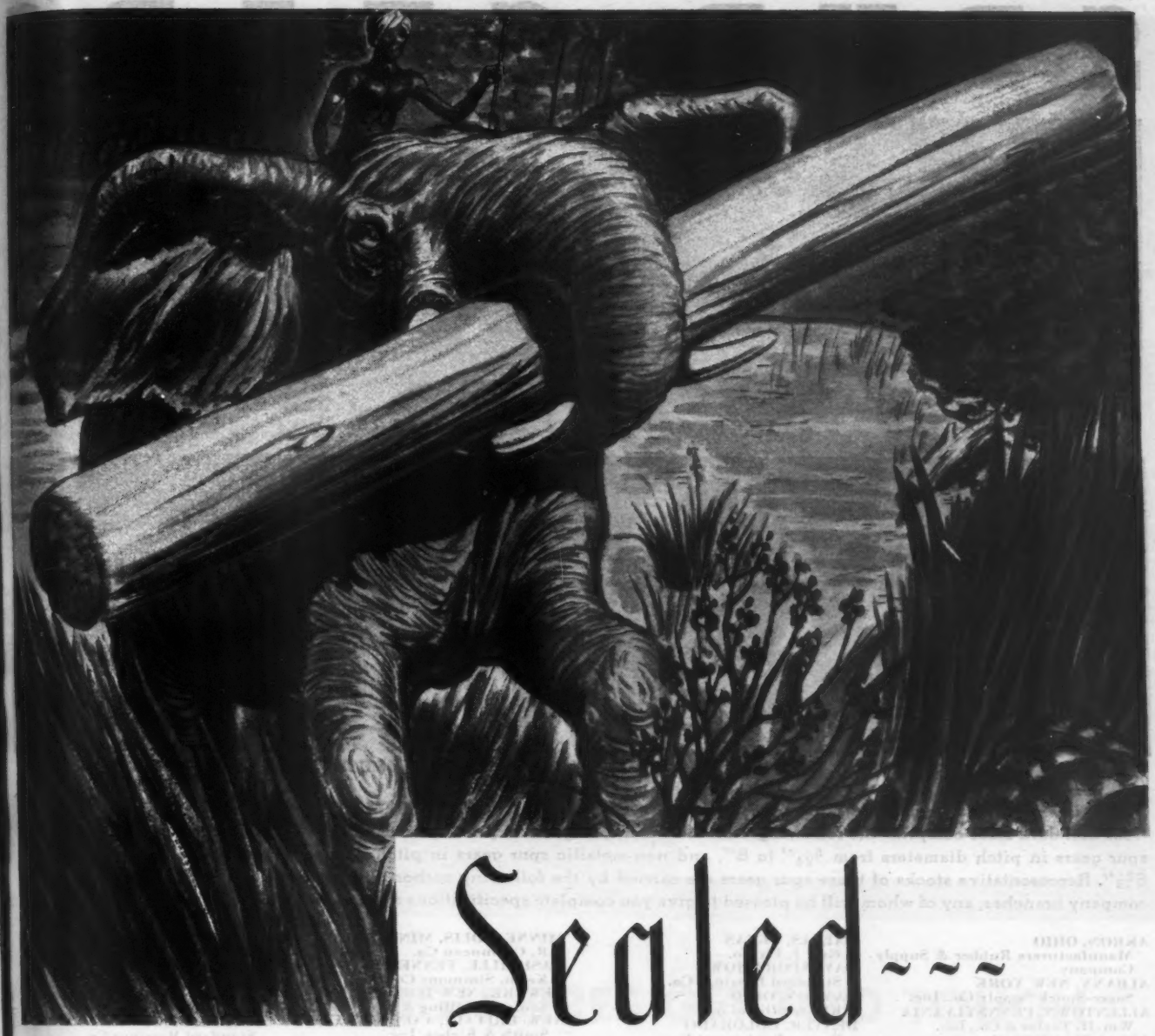
Rex Roller chain belts are the answer to any problem involving the positive transmission of power or timing of operations. The Rex Man can help you with your chain belt application problems. And, for engineering data, ask for the 768 page catalog No. 444. Chain Belt Company, 1715 West Bruce Street, Milwaukee 4, Wisconsin.

REX CHAIN BELTS

More than 2000 sizes and types for the positive transmission of power, timing of operations and conveying of materials.

CHAIN BELT COMPANY OF MILWAUKEE

Rex Chain Belt and Transmission Division, Rex Conveying and Engineering Products Division, Milwaukee 4, Wis. · Baldwin-Duckworth Chain Belt Division, Springfield 2, Mass.; Worcester 3, Mass

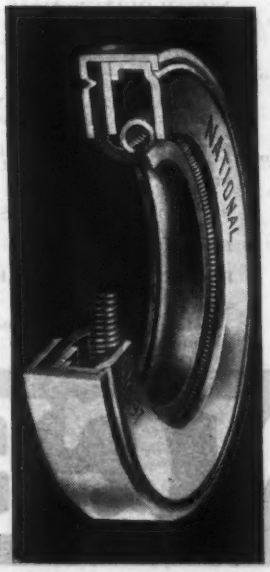


Sealed~~~

● Teakwood from the jungles of Malaya. Hard and strong, and does not warp or crack; protected by its oil against the ravages of time and of the elements.

Protected by its oil . . . yet there are only time and the elements, and not the fast moving parts of a modern machine. Parts that must be protected by their oil, or else they fail, and human lives are endangered, or destroyed.

National Oil Seals do that job; keep the vital bearings bathed in oil. National Seals, engineered for all the exacting requirements of modern machinery, in the world's most modern plants devoted entirely to oil retention problems.



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Wherever shafts move

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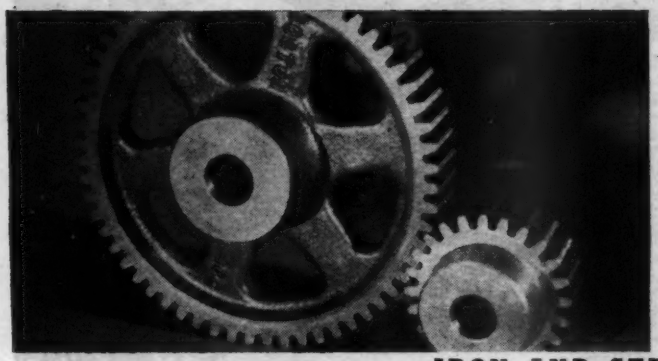
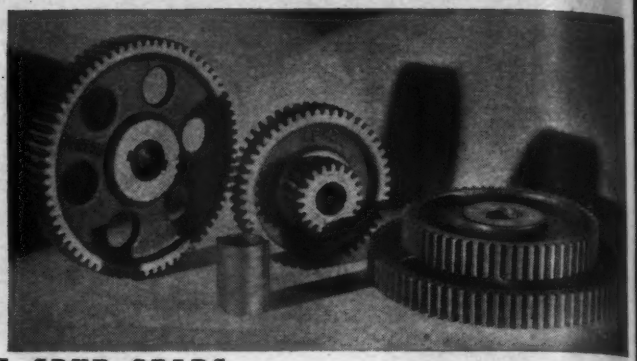
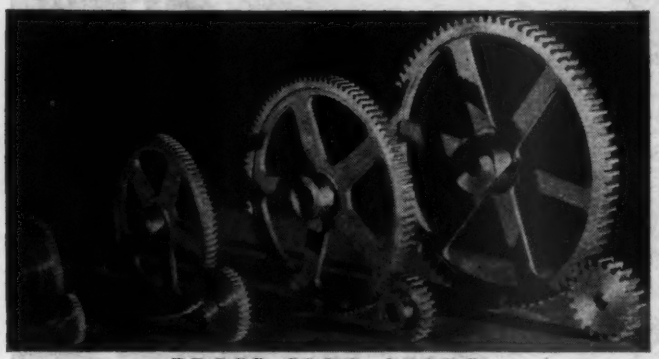
SPUR GEARS

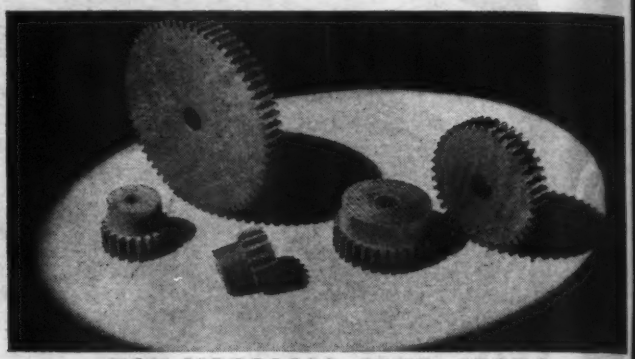




IRON AND STEEL SPUR GEARS



BRASS SPUR GEARS



NON-METALLIC SPUR GEARS

Many sizes of Boston Gear Standard spur gears are IN STOCK READY FOR YOUR IMMEDIATE USE. Boston Gear Standard sizes comprise the following: iron and steel spur gears in pitch diameters from ½" to 40", brass spur gears in pitch diameters from 5/24" to 6", and non-metallic spur gears in pitch diameters from 15/16" to 6⅔". Representative stocks of these spur gears are carried by the following authorized distributors and direct company branches, any of whom will be pleased to give you complete specifications and prices of these products.

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ALBANY, NEW YORK
Sager-Spuck Supply Co., Inc.
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ATLANTA, GEORGIA
J. M. Tull Metal & Supply Co.
BALTIMORE, MARYLAND
Carey Machinery & Supply Co.
BOSTON, MASSACHUSETTS
Boston Gear Works, Inc.
Chandler & Farquhar Co., Inc.
BRIDGEPORT, CONNECTICUT
Hawley Hardware Co.
BROOKLYN, NEW YORK
H. L. Dickie
BUFFALO, NEW YORK
Root, Neal & Co.
BURLINGTON, NORTH CAROLINA
Kester Machinery Co.
CANTON, OHIO
Manufacturers Rubber & Supply Company
CHARLOTTE, NORTH CAROLINA
Mathews-Morse Sales Co.
CHICAGO, ILLINOIS
Berry Bearing Co.
Boston Gear Works, Inc.
Chicago Pulley & Shafting Co.
Power Transmission Equipment Company
CINCINNATI, OHIO
Queen City Supply Co.
CLEVELAND, OHIO
Boston Gear Works, Inc.
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DALLAS, TEXAS
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DAYTON, OHIO
Klinger-Dills Co.
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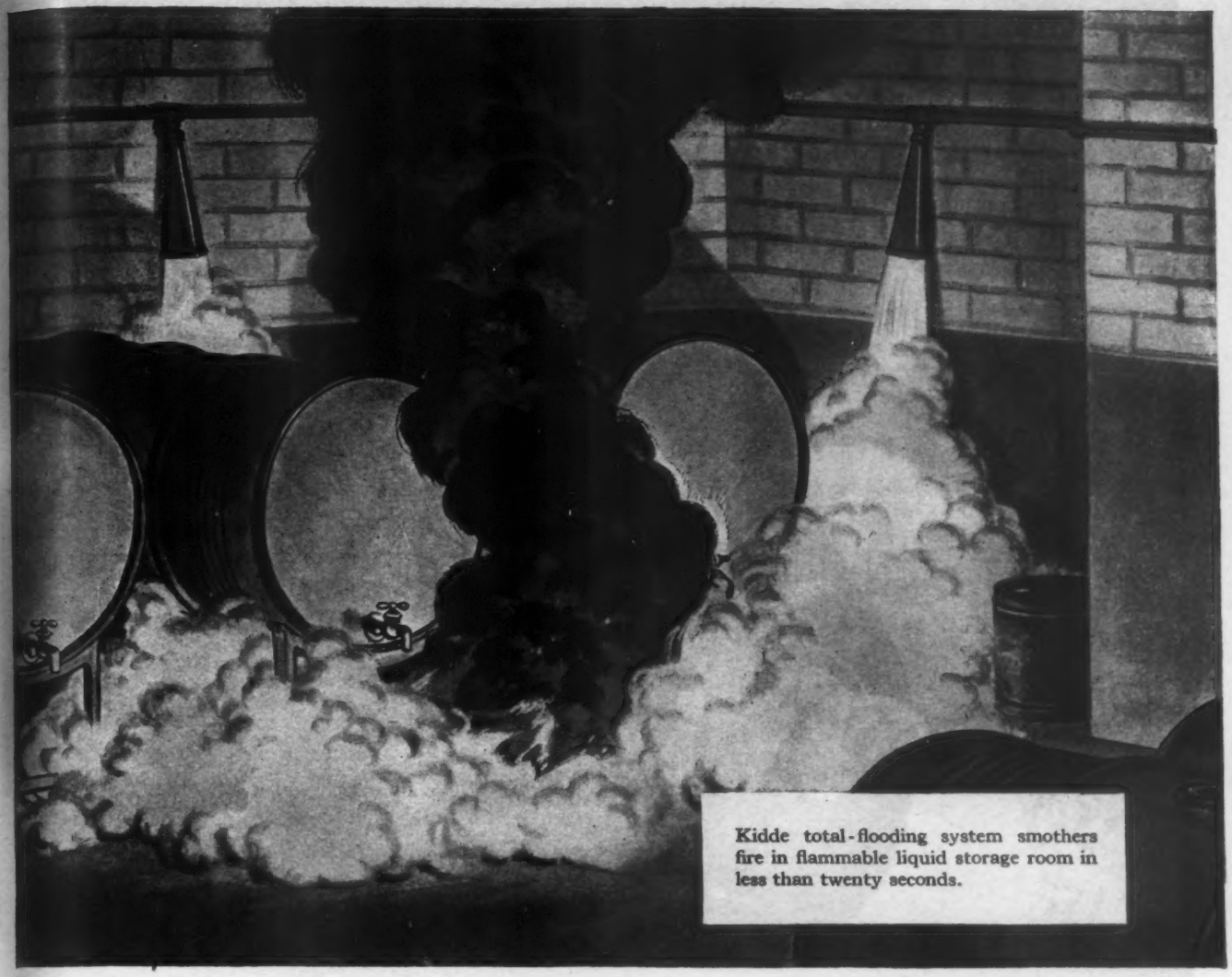

Kidde total-flooding system smothers fire in flammable liquid storage room in less than twenty seconds.

BEFORE TOUGH FIRES GET TOO TOUGH

. . . *blast them out with Kidde!*

In fighting the tough fires—the fast-moving ones that break out in flammable liquids (class B); and the hard-to-get-at types that start in electrical installations (class C)—you've got to smother them fast or they'll spread beyond control in a few minutes.

Ordinary water-type extinguishers can't control these tough fires. But built-in Kidde systems, employing carbon dioxide, will smother them in a matter of seconds. That is why Underwriters' and Factory Mutual Laboratories approve Kidde for fighting *both* these types of fire.

Some of the Kidde built-in systems are so designed that the fire can be automatically isolated, and the room quickly filled with flame-suffocating carbon dioxide. This gas—being dry, inert, odorless and non-toxic—leaves no after-fire mess to be cleaned up, cannot damage any materials; and does not contaminate or otherwise spoil costly processes. In brief, Kidde is one of the speediest, cleanest and most effective fire extinguishers in use today.

So, check this list (at right) now. Does even *one* of these hazards exist in your plant? If it does, write Kidde today. Ask to have a Kidde representative call upon you. He'll be glad to share his fire-prevention know-how with you.

KIDDE KILLS TOUGH FIRES

- Process Rooms
- Ovens
- Spreaders
- Motors
- Storage Rooms
- Mixers
- Coaters
- Transformers
- Dip Tanks
- Agitators
- Washers
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Walter Kidde & Company, Inc. • 140 Cedar Street • New York 6, N. Y.

TRANSMISSIONEERED MEANS ADVANCED DESIGN IN POWER DRIVES

Put the Dodge Transmissioneer on your Staff

When it's a matter of putting power to work — all of it—it's a job for the Dodge Transmissioneer. These specialists are graduates of a factory course in "transmissioneering" who know how to solve power drive problems effectively and economically.

Transmissioneered means advanced design in power drive equipment. Dodge Transmissioneers work with a complete line of standardized and precision-built bearings, sheaves, pulleys, clutches and other drive components which insures "The Right Drive for Every Job".

Whether your problem is one of stepping up war production or planning for reconversion, the Dodge Transmissioneer — your local Dodge distributor — can give you valuable counsel and, in many cases, supply your immediate needs from his local stock. Put him on your operating staff — his service is as close as your telephone.

DODGE MANUFACTURING CORPORATION
Mishawaka, Indiana, U. S. A.

BUY MORE WAR BONDS

DODGE

The Sign of the Dodge Transmissioneer

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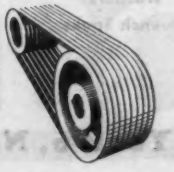
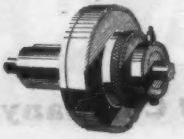


The Right Drive for every Job



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No. 17

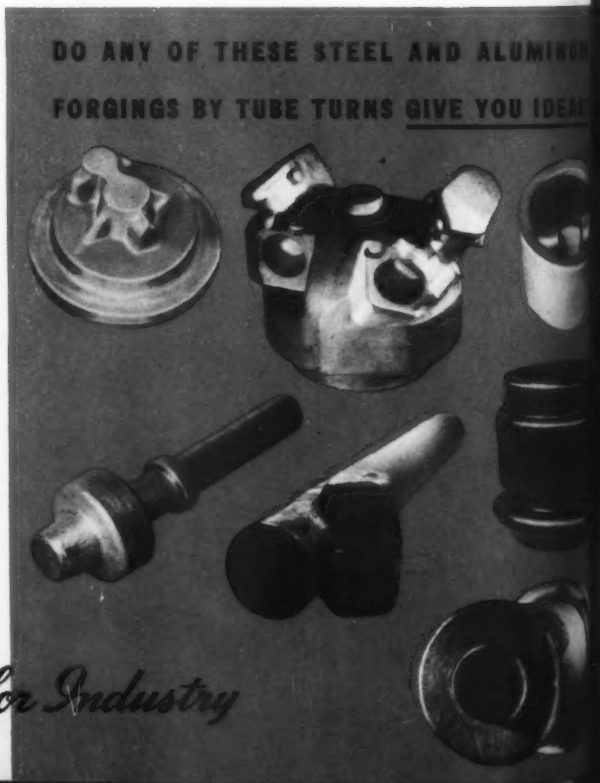
1944

"I'M GETTING TUBE TURNS' OPINION ON ITS FORGE-ABILITY"

Perhaps *you* have a part or product that forging would improve . . . or a present forging job that could be bettered in precision, cost or service.

We welcome opportunities to tackle difficult upset or press forgings, in either steel or light metals. At Tube Turns you'll find a stimulating kind of cooperation — in which practical forging skill and engineering knowledge are accented by resourceful thinking and original techniques. You'll find laboratories that offer virtually every modern method for mechanical, chemical and electrical research and testing. You'll find ample production facilities for volume output plus exacting accuracy — upsetters and presses in sizes up to the largest, heat treating furnaces of the most recent types and one of the largest die shops in the country.

That's why you often hear it said, "I'm getting Tube Turns' opinion" . . . and its sequel, "We're giving Tube Turns the job."—TUBE TURNS (Inc.), Louisville 1, Ky.



TUBE TURNS *Forgings for Industry*

FENN FOR SPECIAL MACHINERY

FENN FOR SPECIAL TOOLS

FENN FOR SPECIAL PARTS

Reconversion to peacetime production is the problem that every manufacturer faces. Plans may necessitate redesigning present machines and building new ones. There is no time to waste.

The survival of many plants will depend largely upon the careful planning that they do now for machines and tools to be used in postwar production.

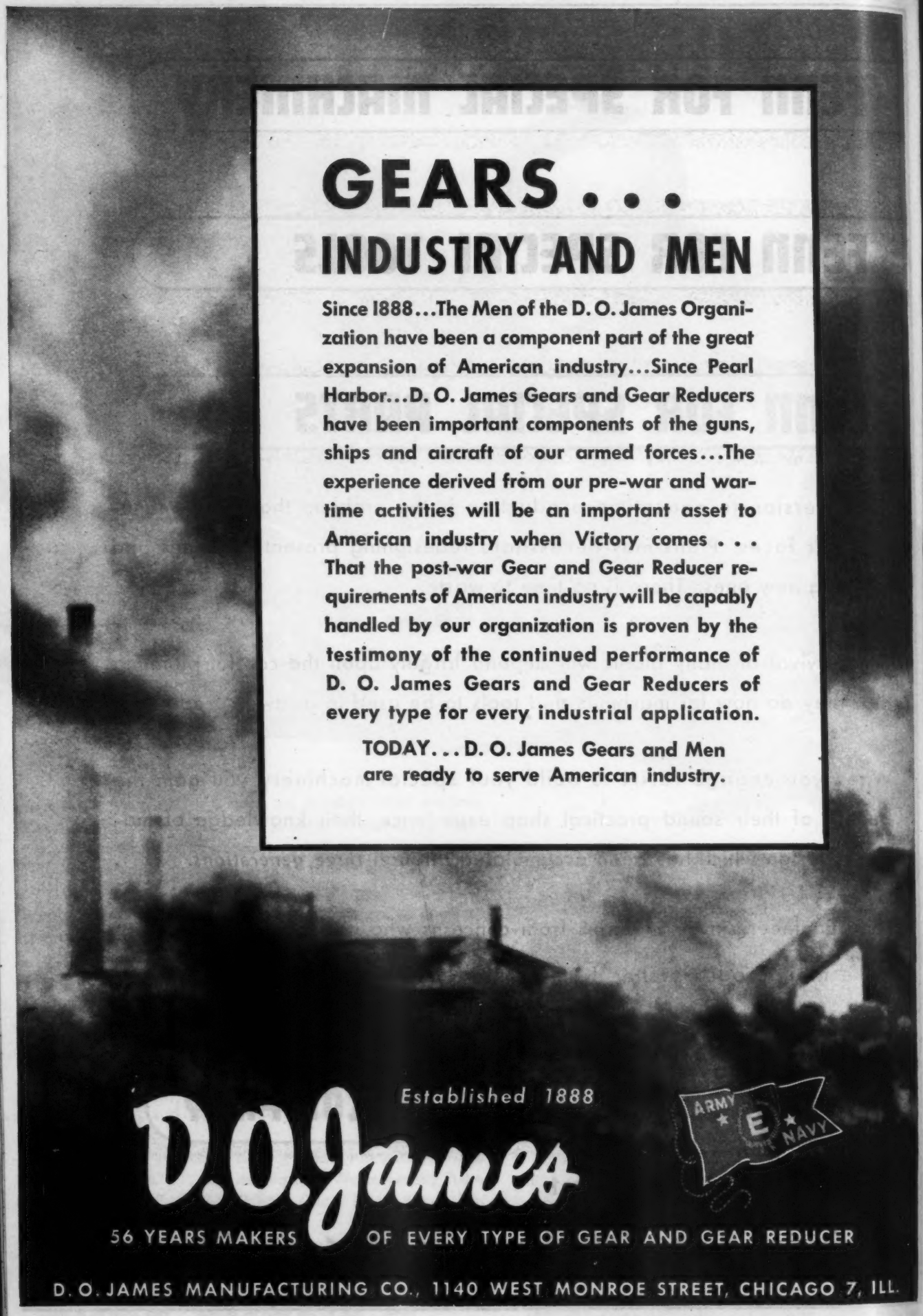
When you engage FENN to build your special machinery you gain the benefit of their sound practical shop experience, their knowledge of machine design which has been accumulated through *three generations.*

Fenn Engineers invite inquiries from concerns who are looking for ways to make their product better, faster, or for less money — concerns that are ready to talk about production at a profit.

THE FENN MANUFACTURING COMPANY

Hartford, Connecticut

Builders of Better Machinery To Meet New Demands


GEARS . . .
INDUSTRY AND MEN
Since 1888...The Men of the D. O. James Organization have been a component part of the great expansion of American industry...Since Pearl Harbor...D. O. James Gears and Gear Reducers have been important components of the guns, ships and aircraft of our armed forces...The experience derived from our pre-war and wartime activities will be an important asset to American industry when Victory comes . . . That the post-war Gear and Gear Reducer requirements of American industry will be capably handled by our organization is proven by the testimony of the continued performance of D. O. James Gears and Gear Reducers of every type for every industrial application.
TODAY... D. O. James Gears and Men are ready to serve American industry.
Established 1888
D.O.James
ARMY E NAVY
56 YEARS MAKERS OF EVERY TYPE OF GEAR AND GEAR REDUCER
D. O. JAMES MANUFACTURING CO., 1140 WEST MONROE STREET, CHICAGO 7, ILL.

Design value

goes beyond

price

What does one designer build into his product that makes it sell at a profitable price, while a competing article loses money for its producer?

Little things, often hidden things. Little things that make a big difference, like Lord Shear Type Mountings of Bonded Rubber.

Where there is machinery in motion, there is vibration, and vibration means strain to machine and to man. Lord Shear Type Mountings and other bonded rubber products control and isolate vibration.

Factories that are quieter, pleasanter, more efficient; automobiles, trucks, buses, locomotives, airplanes that are smoother and safer in operation; delicate laboratory equipment that is made more accurate and trust-worthy; these are the results that Lord is helping designers and manufacturers to accomplish.

The science of vibration control and isolation has been developed by Lord for more than twenty years. This accumulated experience is available to you, without cost, whenever you are faced with a vibration problem.

Write for free literature which will bring you up to date in factual information on vibration control. Lord Vibration Engineers will work with you to bring your product to a new standard of perfection.

LORD
BONDED RUBBER
Shear Type
MOUNTINGS

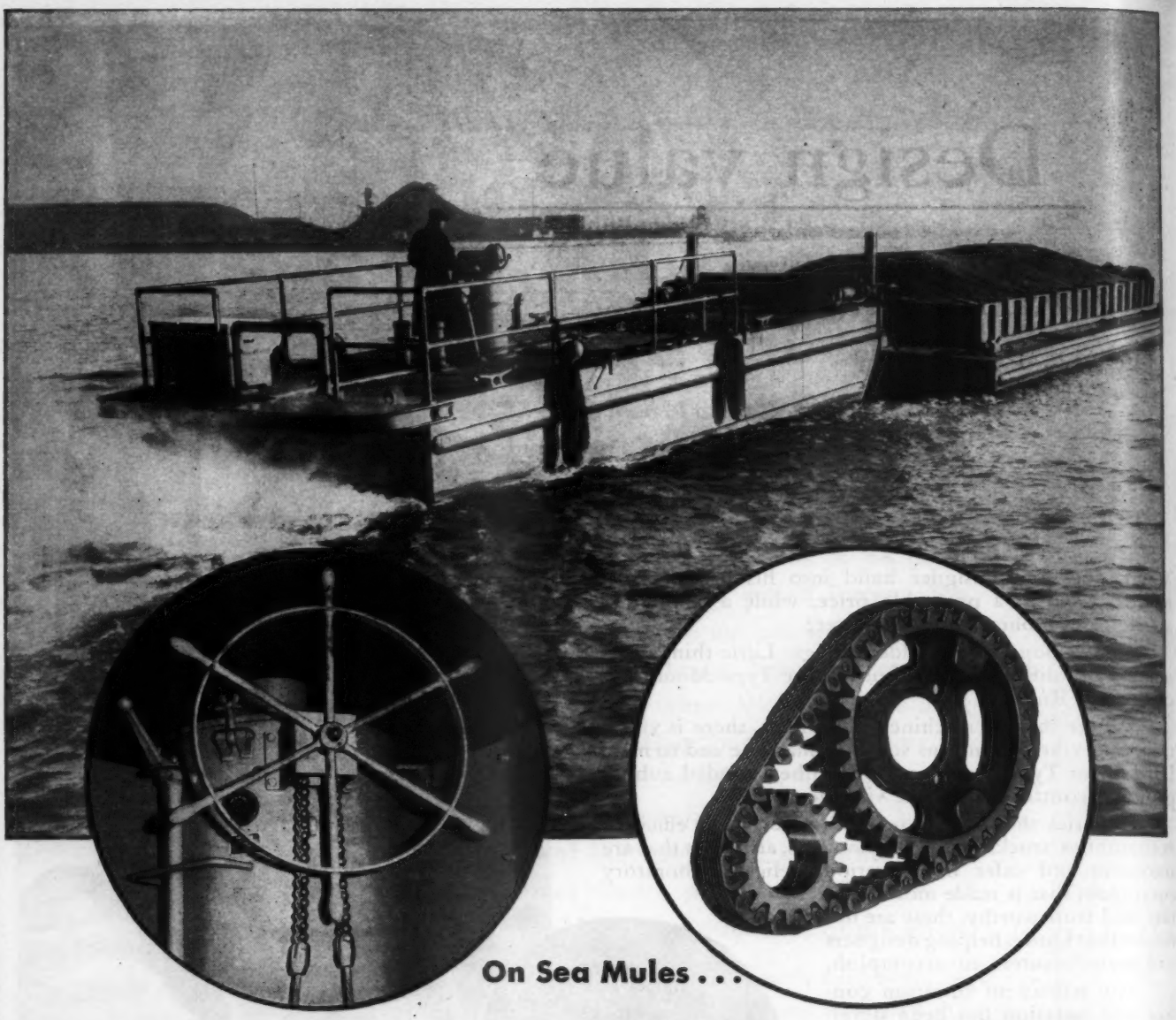
Buy More War Bonds

IT TAKES RUBBER *In Shear* TO ABSORB VIBRATION

LORD MANUFACTURING COMPANY
ERIE, PENNSYLVANIA

SALES REPRESENTATIVES
NEW YORK - - 280 MADISON AVE.
CHICAGO - 520 N. MICHIGAN AVE.
DETROIT - - 7310 WOODWARD AVE.
BURBANK, CAL. - 245 E. OLIVE AVE.
CANADIAN REPRESENTATIVES
RAILWAY & POWER ENGINEERING CORP., LTD.
TORONTO, CANADA

Originators of Shear Type Bonded Rubber Mountings



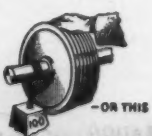
On Sea Mules . . .

CHAIN means *POSITIVE CONTROL*

When invasion calls for dependable sea mule tractor and tug operation, there is no substitute for the positive power transmission and control which only chain can provide.

On the sea mule tractors and tugs Morse roller chain provides sure steering wheel control, and Morse silent automotive timing chains on the engines help maintain smooth, trouble-free operation under severe conditions.

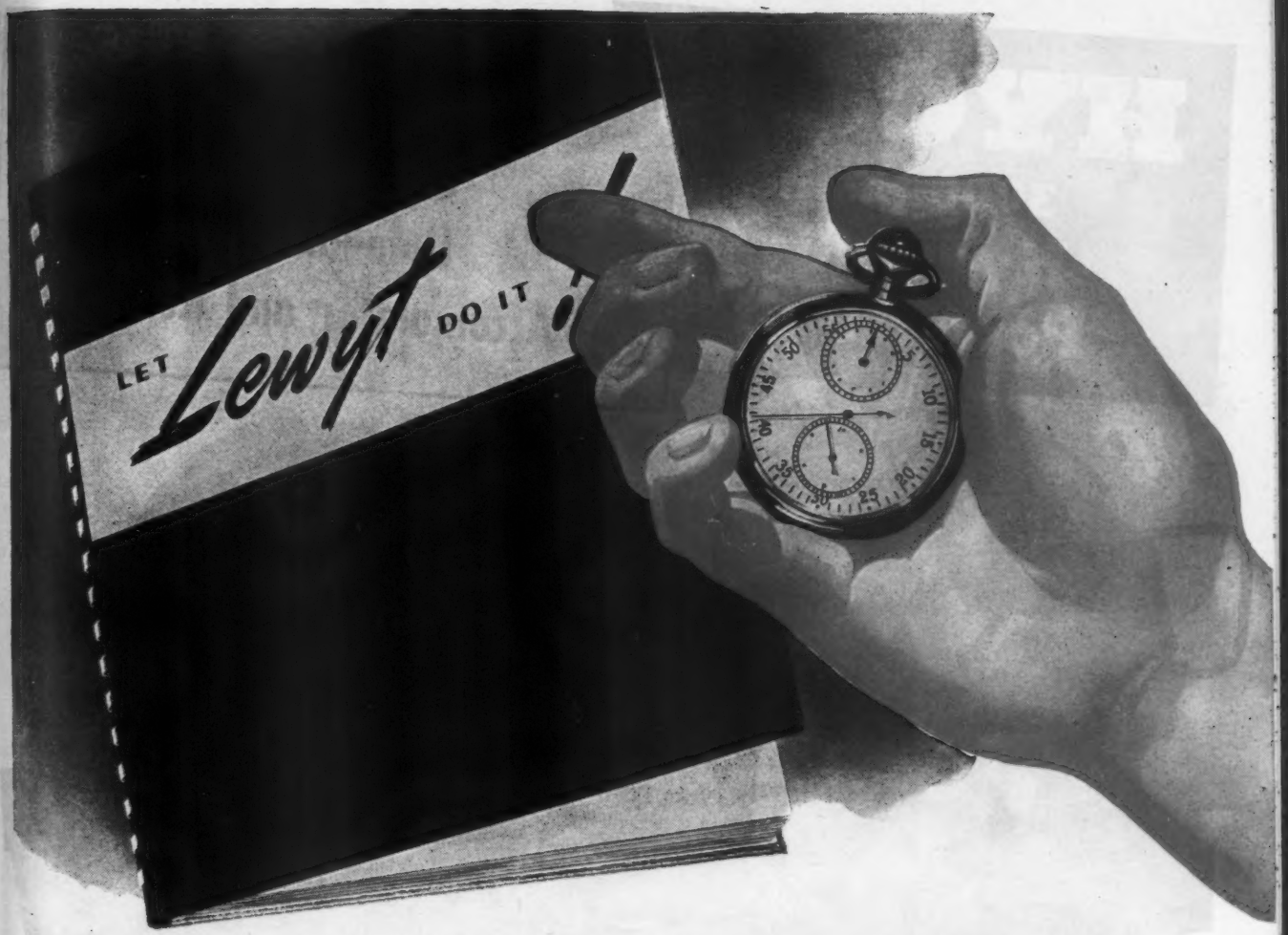
When you have a problem of power transmission or control, take advantage of the Morse engineer's background of a half century's experience. He invites your consultation.



SPROCKETS CHAINS FLEXIBLE COUPLINGS CLUTCHES

MORSE *Roller and Silent* CHAINS

MORSE CHAIN COMPANY • ITHACA, N.Y. • DETROIT 8, MICH. • A BORG-WARNER INDUSTRY



C-DAY WILL HOLD A STOP WATCH...

THIS BOOK is designed to help you prepare for CONVERSION DAY . . . it presents the story of a unique institution that may have the answer to your production problem . . . it suggests a plan for putting your new product development *in training* for the post-war starter's gun.

When materials are no longer ear-marked for war . . . when civilian goods are price-marked for peace . . . there will be no glory or profit at the *finish line* for any but the *winners!*

"Cost-Plus" profits will be outlawed . . . wartime regulations will give place to time studies . . . the stop watch will take over control in the competitive race for manufacturing economies.

Lewyt has set the pace in contract manufacturing ingenuity through two post-war periods of business readjustment. We've had long training in cost-sensitive specialization. We're ready to partner with other manufacturers in producing their component electrical and electronic assemblies, chasses and housings . . . or complete units.

With our exceptional facilities and skills in electrical and mechanical parts manufacture carefully developed through 56 years, it will pay you to talk with us . . . at least write for this 48-page book. Ask for "Series B". There is no cost or obligation.

• • •

LEWYT CORPORATION, 68 BROADWAY, BROOKLYN 11, N. Y.

ARMY E NAVY

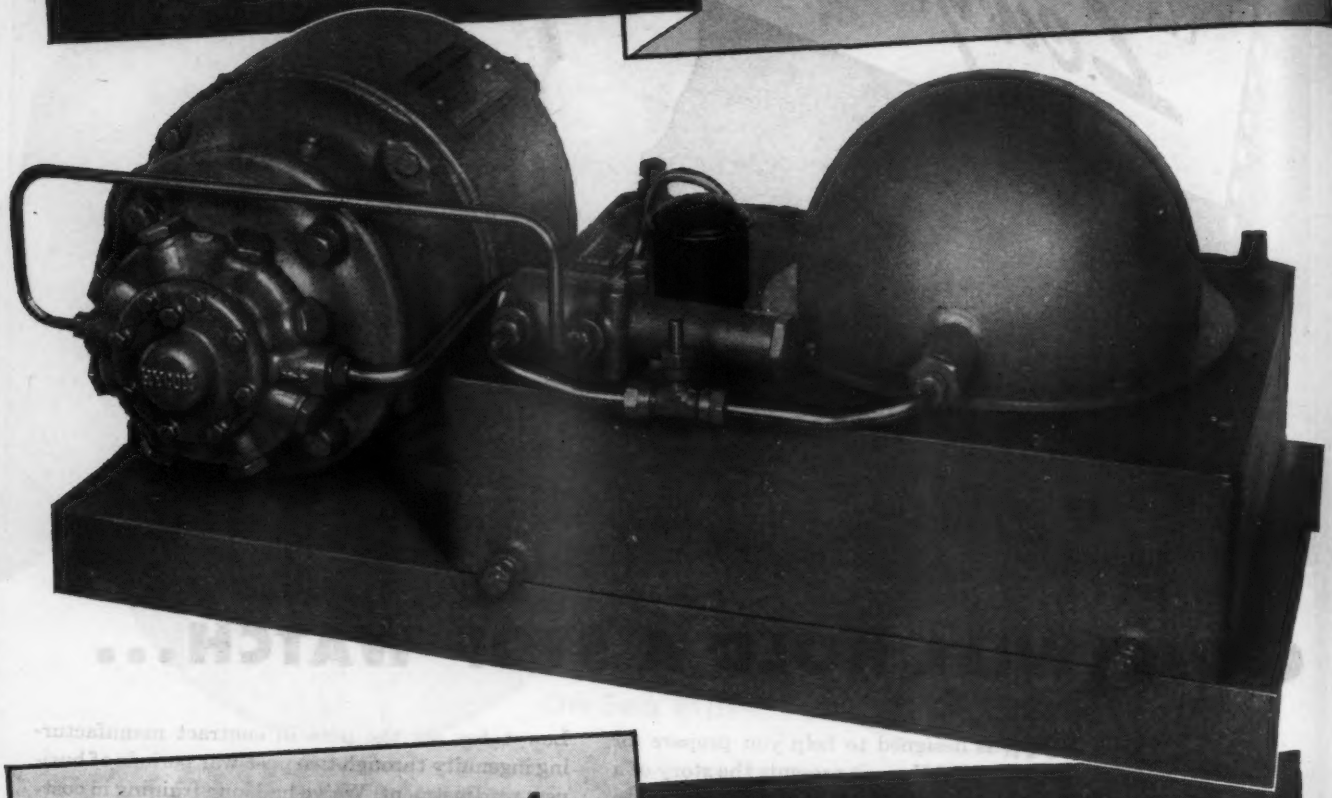
Lewyt

LET LEWYT DO IT

HYCON

3000 p.s.i. Hydraulic Power Unit

3 HP Motor
8 cylinder Pump
Unloading Valve
Accumulator and Reservoir



A small compact unit for machine tools, hydraulic presses and test equipment

Quickly and easily installed for smooth reliable hydraulic operations up to 3000 p.s.i.

Specifications and Engineering Data on Request

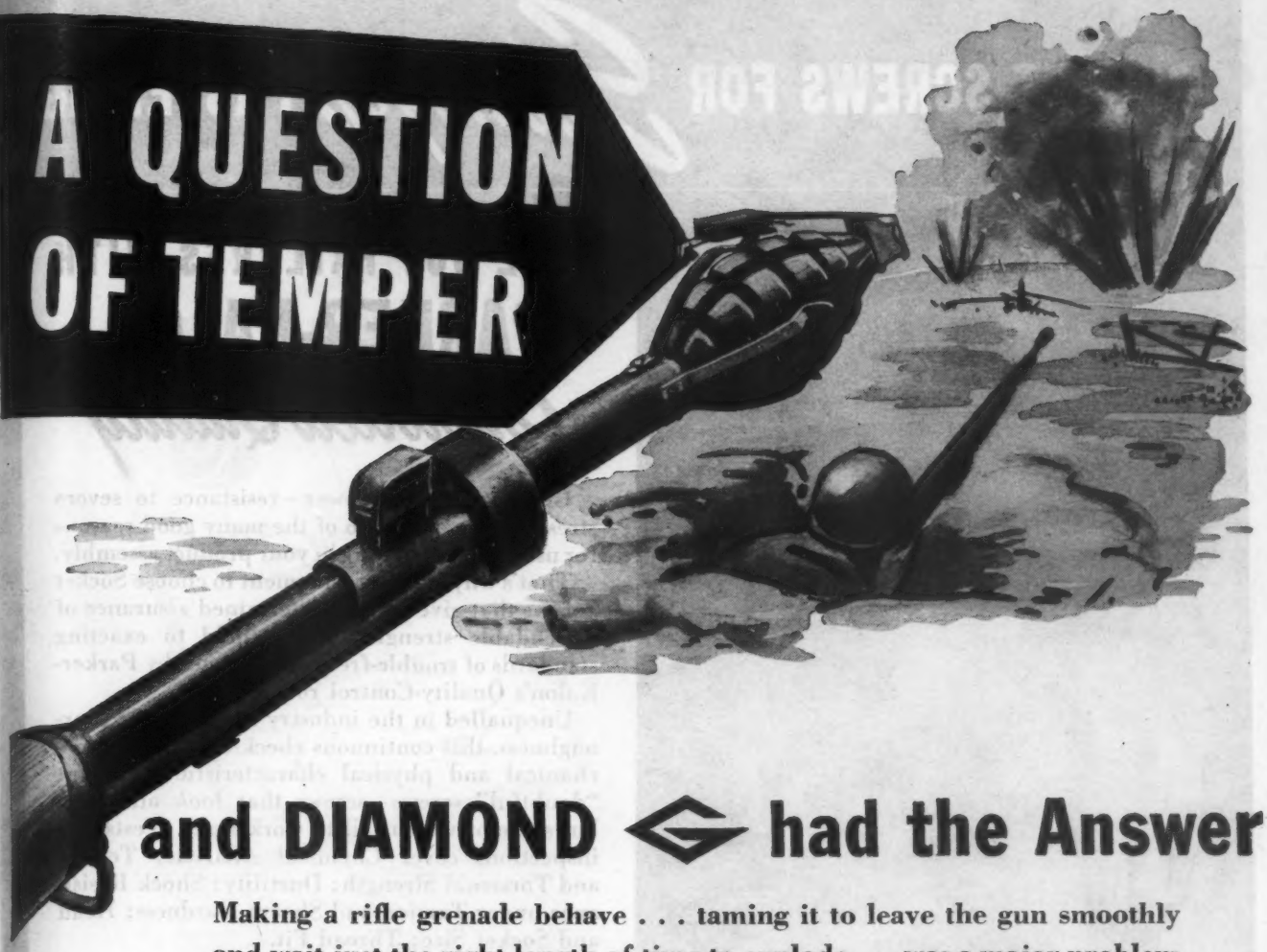
BUY WAR BONDS

THE NEW YORK AIR BRAKE COMPANY

Hydraulic Division

420 Lexington Avenue, New York 17, N. Y. Factories: Watertown, N. Y.

A QUESTION OF TEMPER



and DIAMOND G had the Answer

Making a rifle grenade behave . . . taming it to leave the gun smoothly and wait just the right length of time to explode . . . was a major problem for Army engineers. A tiny flat piece of steel . . . tempered to spring resiliency on one end and brittleness on the other . . . turned the trick. And Diamond G was given this job of "double-duty" tempering . . . just one of hundreds of heat-treating, annealing, stamping and precision-engineering jobs we are called upon to handle.

Our extensive, modernly equipped plant . . . 100,000 sq. ft. of floor space devoted to mass production of the famous "Controlled Tension" Diamond G Lockwashers and Flat Washers . . . is at your continuous service for design, fabrication, heat-treating, stamping and record delivery of metal products of every description.

Put your problem up to Diamond G engineers . . . for speed and economy of production. Your letter or phone call rates our immediate attention.

ARMY E NAVY

GEORGE K. GARRETT CO.
1421 CHESTNUT ST., PHILADELPHIA 2, PA.

DIAMOND G PRODUCTS

SOCKET SCREWS FOR *Stronger* FASTENINGS

RULE OUT FAILURES WITH PARKER-KALON *Controlled Quality*

Greater holding power – resistance to severe stresses – these are two of the many good reasons for using Socket Screws in your product assembly.

That's why it's good judgment to choose Socket Screws that give you predetermined assurance of dependable strength – screws held to exacting standards of trouble-free performance by Parker-Kalon's Quality-Control routine.

Unequalled in the industry for scientific thoroughness, this continuous check-up of every mechanical and physical characteristic rules out "doubtful" screws – screws that *look* all right, but some of which fail to work right. Tests and inspections cover Chemical Analysis; Tensile and Torsional Strength; Ductility; Shock Resistance under Torsion and Shear; Hardness; Head and Socket Size; Thread Fit.

Specify Parker-Kalon Socket Screws next time you order . . . they cost no more. Parker-Kalon Corp., 208 Varick St., New York 14, N. Y.

PIPE PLUGS CAP SCREWS STRIPPER BOLTS SET SCREWS

PARKER-KALON
Quality-Controlled
SOCKET SCREWS

A product of PARKER-KALON ... Specialists in Fastening Devices

FOR A WORLD OF USES

A GOOD TIME TO CHANGE

ARE YOU one of those who is "going back to making our old lines again"?

The old lines may still be the best of their kind, but the *old way* of making them may not be the best. A good example is the equipment manufacturer who was looking for ways of cutting down on the number of operations needed to machine shoulders in his castings to hold the bearings. In search of a less costly way, a Fafnir engineer was called in. On his advice an entirely different type of ball bearing was substituted which resulted in the elimination of several operations with no sacrifice in performance.

Why not call in a Fafnir field engineer to advise you on your old products or new ones you are planning? He may be able to help you to cut costs, improve performance. He has done it for many others. The Fafnir Bearing Company, New Britain, Connecticut.

FAFNIR
BALL BEARINGS

BUY MORE WAR BONDS AND STAMPS

IF YOU HAD AN X-RAY EYE

YOU'D SEE WHY RESISTOFLEX HOSE* IS DIFFERENT

No hose can be more efficient than its tube. And if you were able to see through a Resistoflex hose that had been used for years, you would see the compar tube, unchanged since its original installation.

For compar is an elastomer that varies in formulation according to the job it is to do. Compar is completely immune to the corrosive and erosive attacks of gasoline, fuel oils, organic solvents, hydraulic fluids and lubricants. That is why compar *cannot* shrink in diameter... neither can it swell, rot, nor slough-off.

You would also see a tough reinforcement of selected fabric or fine wire spun around the compar tube. Thus, pressure resistance is built up without loss of flexibility.

And for even greater strength, a rugged outer cover of special formulation protects the hose assembly from external abrasion and rough handling as well as the corrosive effects of oil and moisture.

Yes, if you had an X-ray eye you would see compar, reinforcement and outer cover; and you would readily understand why Resistoflex hose has *never failed due to vibration or flex under normal operating temperatures.*

• • •

A staff of engineers, maintained by the Resistoflex Corporation, is prepared and willing to help you with your flexible hose problems. Laboratory technicians will be glad to work out special purpose formulations of compar for you, should your problem require them. A short letter will bring you the benefits of their experience without obligation.

***THE TUBE IS THE HEART OF THE HOSE— INSIST UPON IT BEING COMPAR**

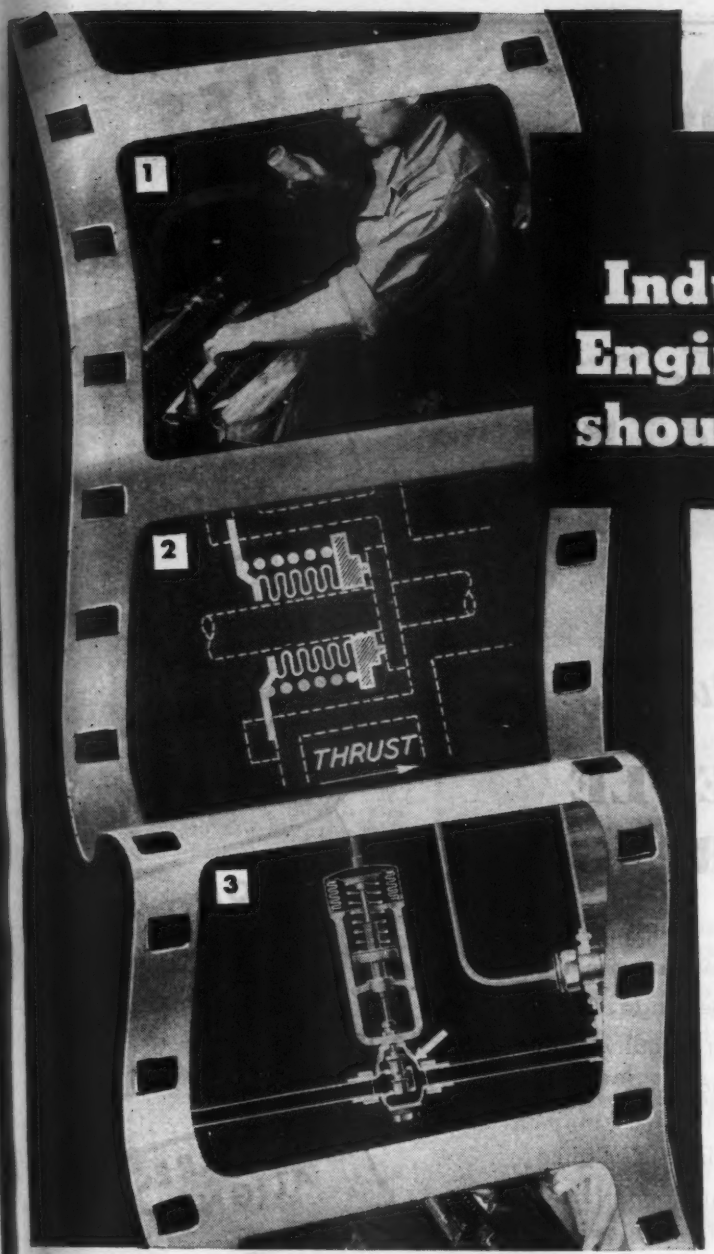
FREON AND METHYL CHLORIDE FLOW FOR YEARS THROUGH GAS-TIGHT RESISTOFLEX ASSEMBLIES

The Dole Refrigerating Company, manufacturers of the famous DOLE VACUUM COLD PLATES use Resistoflex hose to carry freon or methyl chloride from compressors or central charging systems to the cold plates installed in refrigerated trucks and trailers.

Resistoflex hose — because of its compar tube — is non-porous and therefore completely impermeable to most refrigerants. Moreover, the entire hose assembly, though flexible, is so tough it has *never* been known to fail through flexing or vibration under normal operations.

RESISTOFLEX

RESISTOFLEX CORPORATION, BELLEVILLE 9, N. J.



Every Industrial Executive, Engineer and Designer should see this picture

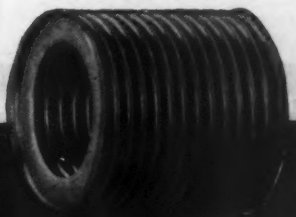
SIMPLE as bellows are, words often fail to show the limitless design possibilities inherent in these versatile metal diaphragms. Too often many engineers have assumed that bellows only had application in a few fields, when actually they have been successfully applied to scores of designs in dozens of different industries.

"*The Story of Metal Bellows*" is an interesting and informative sound film, vividly showing the basic application characteristic of a Sylphon Bellows. It shows just how a bellows converts pressure and temperature changes into controlled mechanical movement, and demonstrates graphically how this movement is harnessed to perform innumerable tasks.

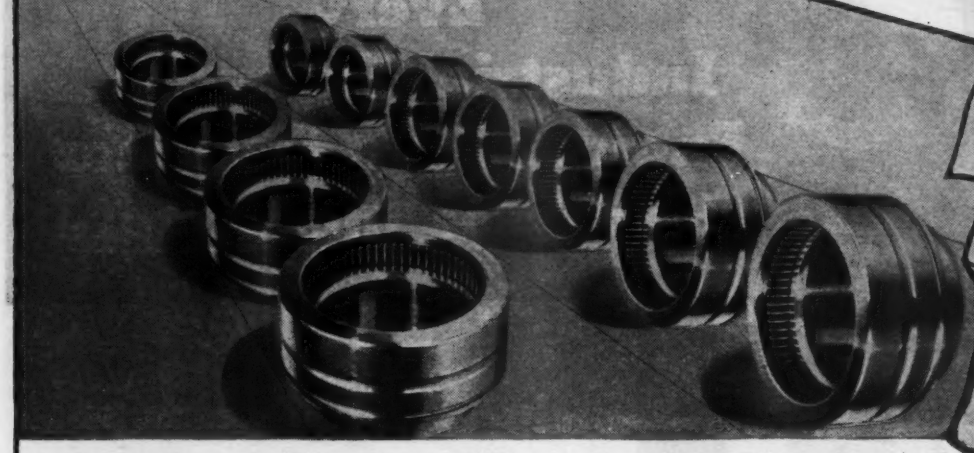
' ' '

This picture is one of the most thought-provoking industrial films ever produced. We are sure your organization will find it stimulating. Let us know when it will be convenient to have this 28-minute sound film shown to your group, at no cost to you. 16 MM or 35 MM film available.

1. A specially designed hydraulic machine forms metal bellows from one-piece tubes.
2. Fundamental applications of bellows are shown in animation . . . may suggest how you can profitably employ Sylphon bellows.
3. This portion of the film explains the operating principle of various types of temperature controls.

FULTON  **SYLPHON**

PRECISION



CLUES to better Bearing Performance

- HIGH LOAD CAPACITY
- LIGHT WEIGHT
- SMALL SIZE
- UNIT CONSTRUCTION
- ECONOMY
- WEAR RESISTANCE
- CORRECT ALIGNMENT
- ALL TYPES— Full Range of Sizes
- PRECISION
- High Carbon Alloy Bearing Steel
- ELIMINATION OF FRICTION
- SILENCE

Another Clue to the Quality of

RBC NEEDLE BEARINGS

EXACT UNIFORMITY

Precise standards have been set up by R B C Engineers to secure strict uniformity in the manufacture of R B C Needle Bearings. These standards involve twenty-five years of bearing inventiveness as applied to design, application and production.

EVEN LOAD DISTRIBUTION

Each size group of R B C Bearings is as alike as two peas in a pod, not only in appearance, but more important in the vital load-carrying units that insure even load distribution. There can be no "lazy relations" in Aircraft, Machine Tool, Pump or Diesel Engine Bearings—each part must do its share of the work.

PUNCTILIOUS ACCURACY

R B C has many special machines and instruments manned by a large percentage of our personnel devoted to the job of inspection. This may be called "Ejecting lazy relations," but the result of this manifold police job is the R B C Bearing which is guilty only of punctilious accuracy.

R B C's ENGINEERING STAFF WILL HELP YOU IN SELECTING THE RIGHT BEARING, AND IN FOLLOWING OUT THE CORRECT BEARING PROCEDURE. LET US KNOW YOUR PROBLEMS.

ROLLER BEARING CO. OF AMERICA
TRENTON, NEW JERSEY

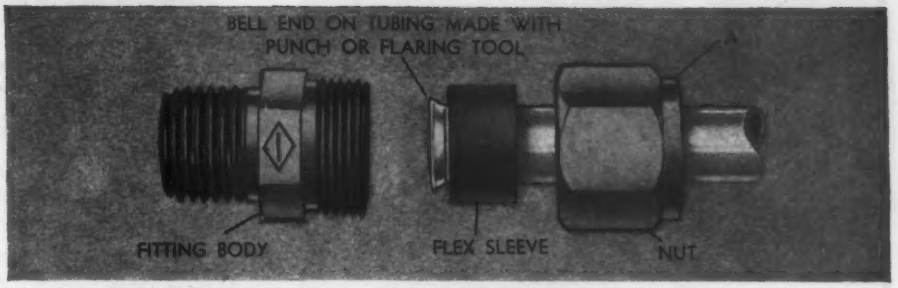
AN IMPERIAL DATA SHEET

Basic Data ON TUBING CONNECTIONS

NO. 5 FLEX FITTINGS

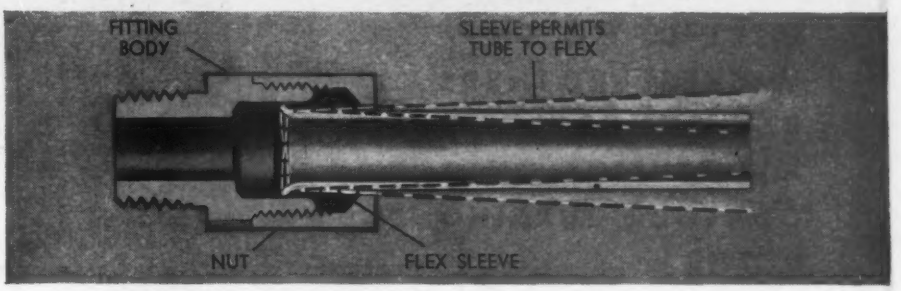
HOW TO RECOGNIZE

Body resembles compression fitting body but has larger opening to take belling on end of tubing. Sleeve is made of synthetic elastic material. Nut resembles compression nut but has distinguishing extension (A) beyond hex.



HOW TO ASSEMBLE

Slip nut and Flex sleeve over end of tube. Bell the end of tube slightly with a flaring tool or 45° punch. Insert tube into fitting body and screw on nut. Sleeve is compressed against end of fitting body and against tube, making a joint that is pressure tight and yet permits tube to flex in any direction.



FOR USE WITH FOLLOWING TYPES OF TUBING

Especially designed for use with thin-wall steel tubing, such as Bundy, and copper tubing. Also can be used with aluminum, brass, Monel and Everdur tubing.

APPLICATIONS

Used for connecting metal tubing where there is major vibration or where parts joined by tubing vibrate in different planes and amplitudes. Used for gasoline, oil and grease lines on automobiles, trucks, tractors, buses, power units, etc., and other low and medium pressure applications. Can be used in many instances in place of flexible lines.

ADVANTAGES

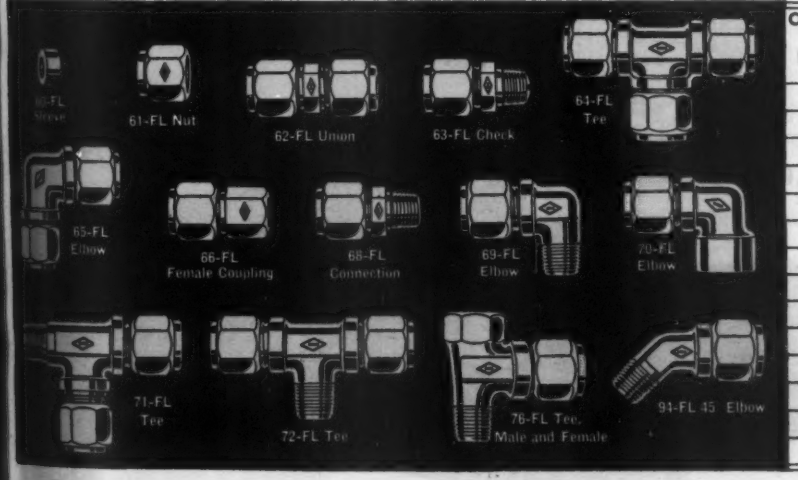
Solves problem of tubing failure resulting from major or minor vibration. In many instances eliminates need for costly flexible lines, effecting substantial savings and providing greatly increased durability.

Sleeve of synthetic elastic material forms a cushion between tubing and fitting so tubing actually can be flexed back and forth in fitting and yet a positive seal is retained. Under tests Flex Fitting joints have withstood over 10,000,000 vibrations without failure.

STOCK SIZES

Most shapes made for ⅛" to ⅞" O.D. tubing. Sizes ordinarily carried in stock are indicated in table below by dots and squares.*

THE IMPERIAL BRASS MANUFACTURING CO., 515 So. Racine Ave., Chicago 7, Illinois



O.D. Tube Size→ by I.P.T. Size→	1/8 1/8 In.	3/16 1/8 In.	1/4 1/8 In.	5/16 1/8 In.	5/16 1/4 In.	3/8 1/4 In.	1/2 3/8 In.	5/8 1/2 In.	3/4 1/2 In.	7/8 3/4 In.
60-FL	●	●	●	●		●	●	●	●	●
61-FL	●	●	●	●		●	●	●	●	●
62-FL	●	●	●	●		●	●	●	●	●
63-FL	■	■	■	■		■				
64-FL	●	●	●	●		●	●	●	●	●
65-FL	●	●	●	●		●	●	●	●	●
66-FL	■	■	■	■		■	■	■	■	■
68-FL	■	■	■	■	■	■	■	■	■	■
69-FL	■	■	■	■	■	■	■	■	■	■
70-FL	■	■	■	■		■				
71-FL	■	■	■	■		■	■	■	■	■
72-FL	■	■	■	■		■	■	■	■	■
76-FL	■	■	■	■		■				
94-FL			■							

*● Fitting has tubing connections only.
■ Fitting has both tubing and pipe thread connections.

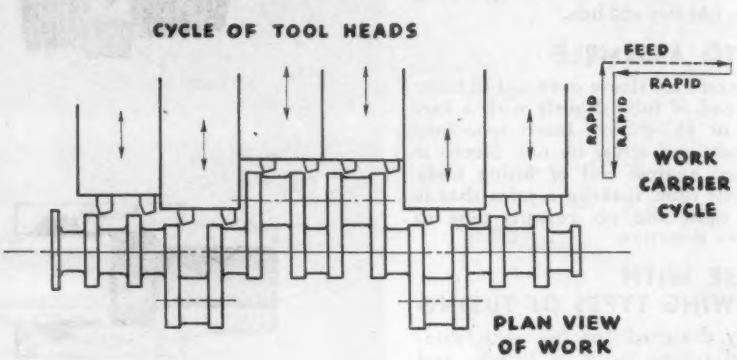
IMPERIAL ★ Headquarters for tube fittings and tube working tools

Reprints of this page will be sent on request

SUNDSTRAND
HYDRAULIC UNITS

Use them to simplify your machine-design problems!

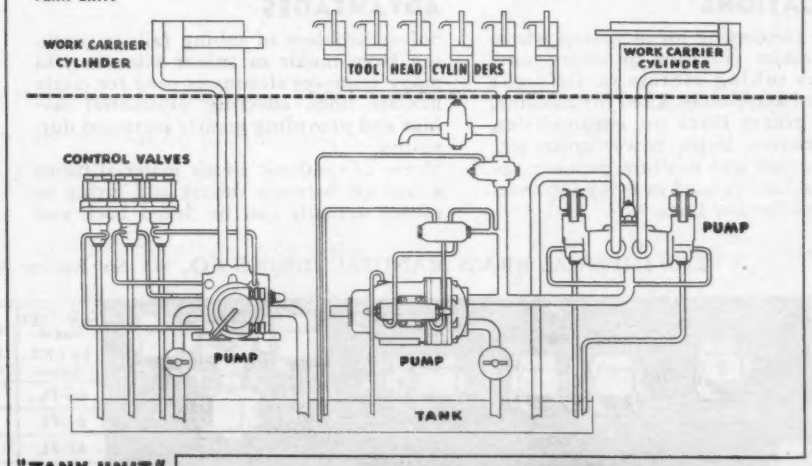
The top drawing is a diagram of the tool and work cycles actuated by Sundstrand Hydraulics on a Wickes Brothers Heavy Duty Contour Turning Lathe which forms the elliptical crank arms on a large multiple throw crankshaft. The diagram below shows the units and piping of the Sundstrand "tank unit" and the associated cylinders in the machine.



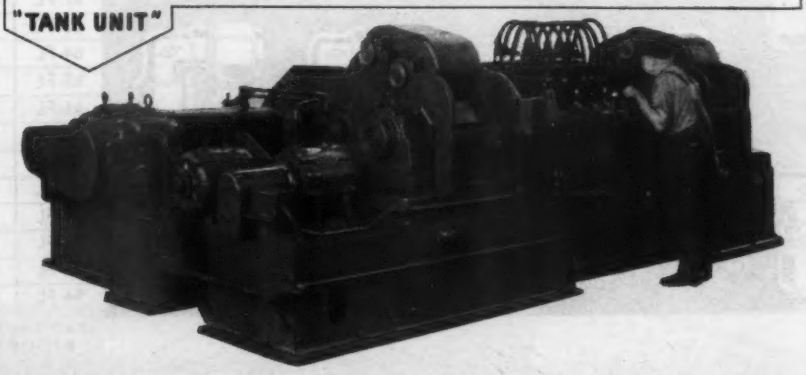
HERE IS HOW WICKES BROTHERS USE SUNDSTRAND HYDRAULICS ON A CONTOUR TURNING LATHE

Illustrated here is a machine-design problem which was greatly simplified by the application of Sundstrand Hydraulics. Six tools independently form specified contours and the work is put through a cycle involving both lateral and longitudinal movements at rapid and working feeds. As shown in the diagram above, the contour movement of each tool is governed by holding the tool carrier against a contour cam with hydraulic pressure. Work carriage movement is governed by two hydraulic cylinders. Motivation for all of these movements comes from the Sundstrand "tank unit".

Movement of six tool heads and work carrier cycle provided by single Sundstrand tank unit.



"TANK UNIT"



A COMPLICATED CYCLE MADE EASY

To control and drive this machine by mechanical or electrical units would necessitate extremely complicated and troublesome mechanisms. Sundstrand Hydraulics can take the "grief" out of many machine-drive design problems, as was done here. Let Sundstrand furnish your power drive and controls. *Get acquainted with Sundstrand Hydraulics!*

SUNDSTRAND PUMP DIVISION

SUNDSTRAND MACHINE TOOL CO. ROCKFORD, ILLINOIS U.S.A.

2556 ELEVENTH ST.
ROCKFORD, ILLINOIS

The Flag Goes Up

—and we'll never let it down!

The conferring of the Army-Navy "E" Production Award has brought full realization to the men and women of Orange Roller Bearing Co., Inc., that this high honor is not easily won, nor lightly retained.

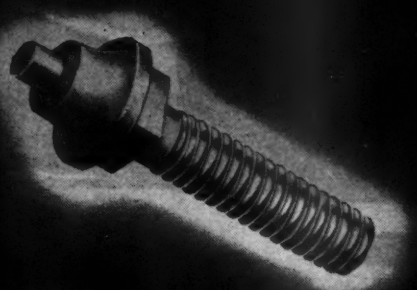
The "E" Flag flies over our plant because every individual worked without let-down to deliver Roller Bearings "on time", as America prepared for the attack. We now pledge to keep that Flag flying high, until complete Victory is won.

We wish also to pay tribute to our employees now in service, and to our suppliers, who contributed greatly to the winning of this award and without whose help it would not have been possible.

ORANGE ROLLER BEARING CO. INC.

ORANGE, NEW JERSEY

FASTENINGS PLANNED NOW MAY MAKE POSSIBLE THAT FAST ASSEMBLY JOB



"Cold-forging"— proof #26... more each month

Early clarification of your plans for fastenings can well be the difference between a fast and precise assembly job and one involving costly delays. Avoid headaches by planning early—in the products design stage—the fastenings required to meet your specific needs. Your choice—standard or special design—is vital not only to fast assembly, but to "making" your product. No product can be better than its fastenings.

One of our jobs at Scovill, as fastenings specialists, is to help you select the best modern fastening for your specific need—a featured standard fastening or a part requiring our ingenuity in special design. And our skill, illustrated in the specially designed cold-forged item above, makes possible delivery at a subtantial saving in money—materials—motions.

Avail yourself now of Scovill ingenuity in standard or special design and cold-forging. Profit by calling a Scovill Fastenings Expert to assist you in your selection. Call *today.*

3 Standard Fastenings for Production Efficiency

1 Phillips Recessed Head Screws—The modern, effective, time-saving fastening device proven in tens of thousands of assembly lines. Other standard head styles are also available.

2 Self-Tapping Machine Screws—Eliminate separate tapping operations for fastenings to castings, heavy gauge sheet metal, and plastics. Also available with Phillips Recessed Head.

3 Washer-Screw Assemblies—When use of lock washers is indicated, the time-saving of pre-assemblies is obvious. Also available in standard slotted head styles.

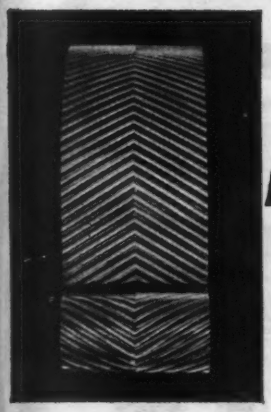
SCOVILL MANUFACTURING COMPANY

WATERVILLE SCREW PRODUCTS DIVISION

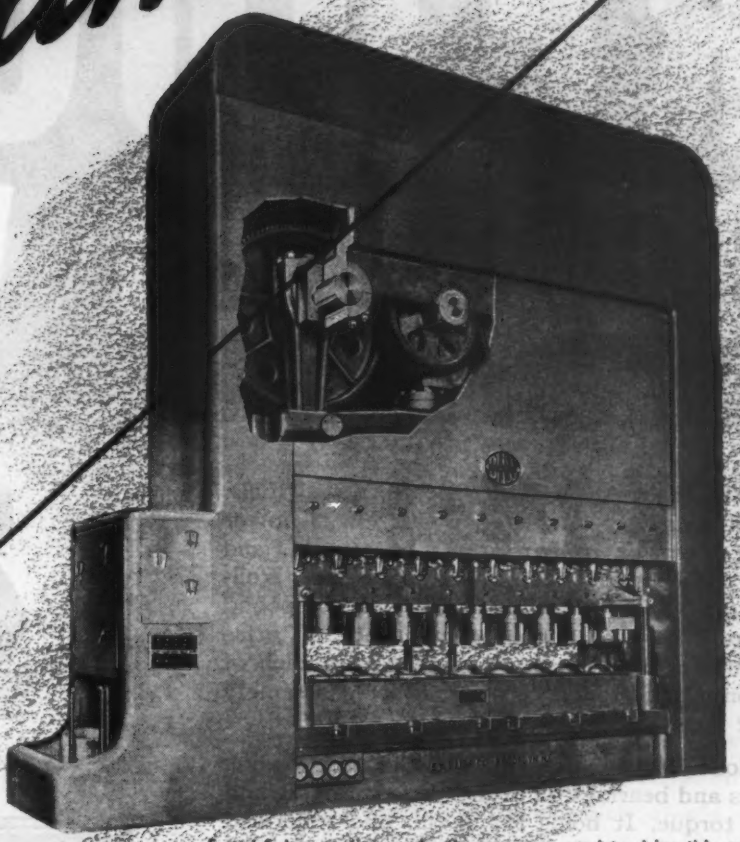
WATERVILLE 48, CONN. TEL. WATERBURY 3-3151

NEW YORK, Chrysler Building • DETROIT, 714 Fisher Building • CHICAGO, 135 South LaSalle Street • PHILADELPHIA, 18 W. Chelten Avenue Building
PITTSBURGH, 2882 W. Liberty Ave. • SYRACUSE, Syracuse-Kemper Insurance Bldg. • LOS ANGELES, 2627 S. Soto St. • SAN FRANCISCO, 434 Brannan St.

AND THE GEARS, TOO, ARE... "Streamlined"



Because the two helices meet, instead of being separated by a center groove, the entire face width of Farrel-Sykes gears is put to work.



Farrel-Sykes continuous tooth gears are used to drive this modern press designed and built by the E. W. Bliss Co. of Brooklyn, N. Y. Totally enclosed and entirely automatic, the press produces an automobile hub cap in ten successive operations, from circular blank to finished article.

A GLANCE at the gears of this press shows that they are the famous Farrel-Sykes continuous tooth type—the *Gear with a Backbone.*

This means that there is no center groove separating the two helices, as is the case with some gears. Instead the teeth meet in sharp apices, which we call the *backbone* because it provides extra strength and higher load-carrying capacity in smaller space. In short, a more compact gear—"streamlined" in the sense of eliminating the unnecessary.

This is only one of the features of these gears. Precision cut by the Farrel-Sykes method of generation, their combined characteristics of overlap or interlacing of the teeth, gradual engagement and inclined line of pressure contribute to smooth, quiet operation and maintenance of correct tooth action throughout the life of the gears. The opposed helices balance and absorb axial thrust within the gear member, preventing harmful thrust loads with resultant stresses on other parts of the machine.

For the complete story of the *Gear with a Backbone* write for a copy of 80-page catalog No. 438. No cost, no obligation.

FARREL

FARREL-BIRMINGHAM COMPANY, INC.

ANSONIA, CONN. **BUFFALO, N. Y.**

Plants: Ansonia and Derby, Conn., Buffalo, N. Y.
Sales Offices: Ansonia, Buffalo, New York, Pittsburgh, Akron, Los Angeles, Tulsa, Houston

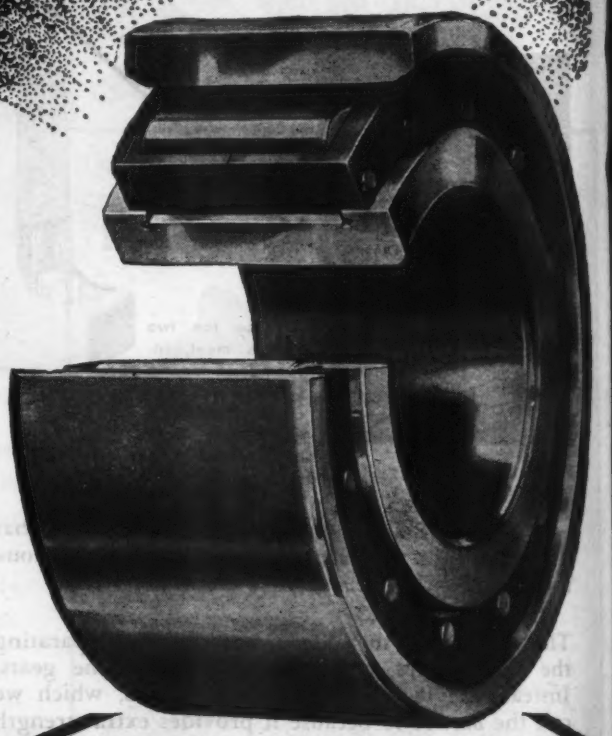
farrel-Birmingham

RIGHT-ANGLE LOADING REDUCES BEARING WEAR

Rollway Right-Angle Roller Bearings will make your machines *last longer . . .* with *lower power costs . . . lower maintenance costs . . .* and *lower replacement costs.* That's because Rollway's *right-angle loading* splits all compound loads into the two simple components of *pure radial* and *pure thrust . . .* and carries each of these components on a separate bearing assembly *at right angles to the roller axis.*

This load simplification reduces the unit loading on rollers and bearings. It insures lower starting and running torque. It holds radius-rub and roller-end wear-back to a minimum. And it eliminates all resultants from oblique loads, and all piling up of load magnitudes. Thus you get *a longer period of precision operation.* And you suffer *fewer shut-downs for bearing adjustment or replacement.*

Don't wait until reconversion problems overwhelm you. Take this important first-step toward postwar preventive maintenance today: Send drawings or detailed description of your postwar applications for free bearing analyses and recommendations by our engineering specialists. No charge. No obligation. S.A.E. and American Standard metric dimensions and tolerances are available for most applications, assuring quick supply and replacement at low cost.



Type MCS double-width Radial —carries all radial loads at right angles to the roller axis. Thrust loads are carried on a separate assembly.

ROLLWAY BEARING COMPANY, INC.
Syracuse 2, N. Y.
since 1908, makers of

ROLLWAY

Right-Angle Loaded
ROLLER BEARINGS

SALES OFFICES: Philadelphia • Boston • Pittsburgh • Youngstown • Cleveland • Detroit • Chicago • St. Paul • Houston • Tulsa • Los Angeles

CONSTANT FLOW OF POWER THROUGH

ROLLING ACTION —

GEARGRIND

have six driving balls, all of them transmitting torque
in either direction of rotation. A close fitting ball cage
correct alignment, an important feature, since it
a plane bisecting the angle between
way the correct basic princi-
and the hazard of
excluded.

RZEPPA CONSTANT VELOCITY UNIVERSAL JOINTS

Catalog on Request

IF YOUR product design calls for the transmission of power from one rotating shaft to another, without vibration and the alternating acceleration and deceleration of old style universal joints, write for the new Rzeppa catalog.

This book explains the mechanical principles involved in transmitting vibrationless, constant, uniform power, and contains diagrams showing the destructive forces set up by older methods of transmitting power through various degrees of angularity.

Rzeppa Universal Joints are made in both the ball and disc types, in a wide range of sizes that are available for many industrial, automotive and marine applications. Full information will be sent on request.

ARMY E NAVY

The GEAR GRINDING MACHINE COMPANY

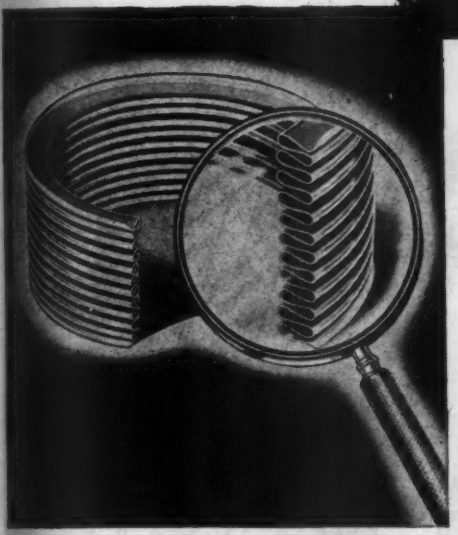
VINCO GEAR ROLLING FIXTURES *with* MASTER GEARS

. . . a positive check for backlash and run-out.

VINCO CORPORATION, 8867 SCHAEFER HIGHWAY, DETROIT 27, MICHIGAN, SALES OFFICES, NEW YORK, CHICAGO, CLEVELAND

MILLIONTHS OF AN INCH FOR SALE BY VINCO

Semi-Automatic Hydraulic Spline and Gear Grinder • Optical Master Inspection Dividing Head • Involute Checker • Angle Tangent to Radius Dresser • Index Plates • Precision Vises • Sine Bars • Straight-side Spline, Serration Spline, Involute Spline and Helical Spline Plug and Ring Gages • Thread Plugs, Rings and Setting Plug Gages • Spur and Helical Master Gears • Munition Gages • Propeller Hub Gages • Built-up and Special Gages • Gear Rolling Fixtures • Spline and Index Fixtures • Hydraulic Power, Control, Utilization and Distribution Units • Engineering, Design and Development.



TIRELESS WORKER!

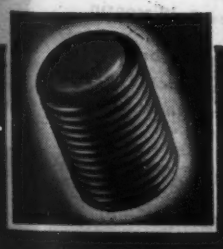
HOUR AFTER HOUR . . . day in, day out . . . a bellows proves a tireless worker *if it fits the job.*

Actually, there's only one best type and size for a particular application . . . the bellows that is engineered to meet all conditions encountered in actual usage.

That is why much care should be taken when selecting a bellows . . . why our engineers insist upon exact data covering every phase of the working conditions under which each bellows is to operate. With these facts at hand they can assure the dependable performance for which Bridgeport Bellows are famous.

Why not consult Bridgeport now regarding your present or post-war bellows requirements? Catalog XP-100, full of valuable information, will be sent upon request.

NOTE UNIT CONSTRUCTION. **Bellows is a one-piece expansible and collapsible member. Side-walls are deeply folded or corrugated as pictured above. No seams or solder.**



Bellows Assemblies . . . Bellows . . . Bellows Devices

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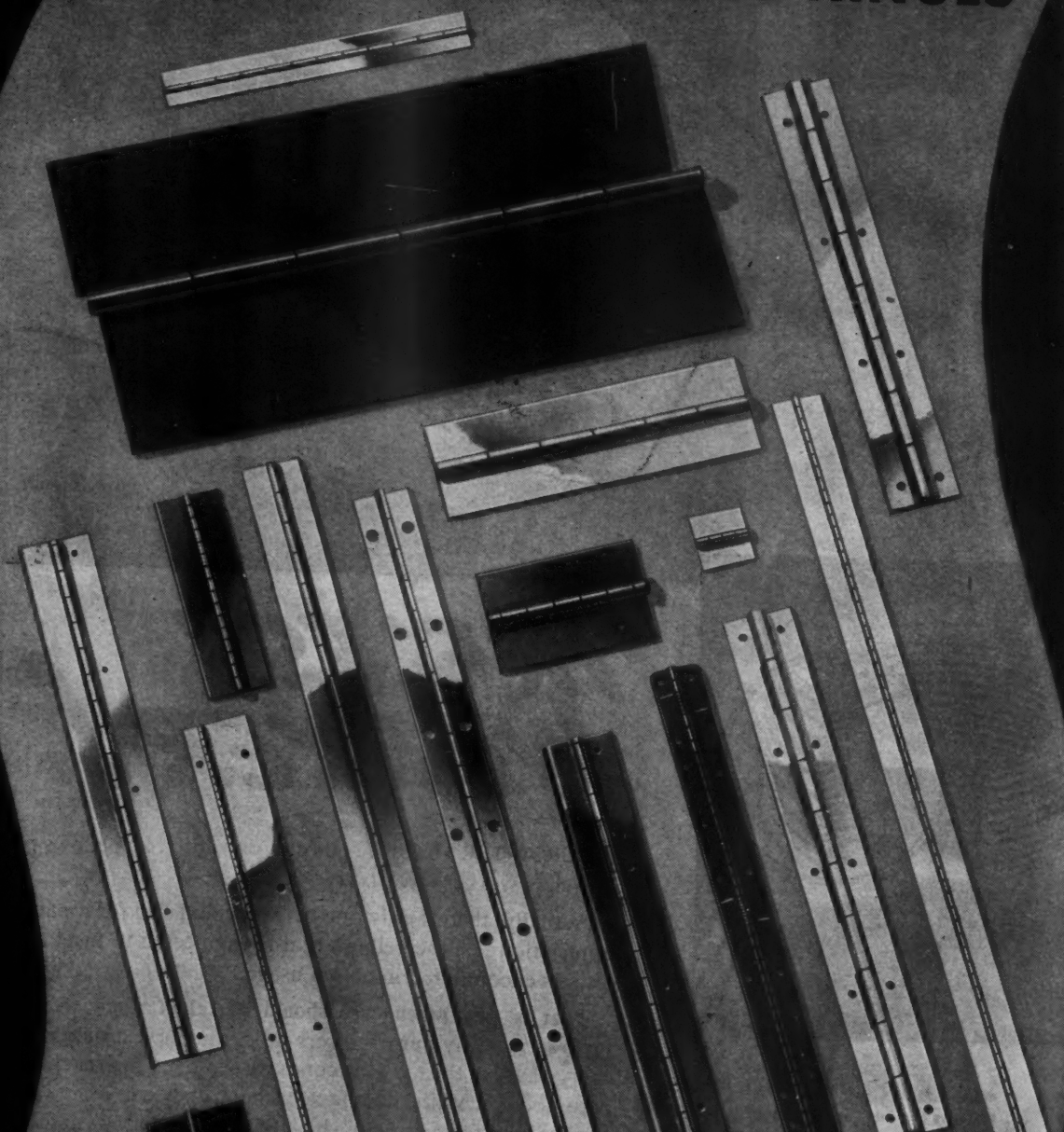
HINGE YOUR PRODUCTS WITH WAGNER CONTINUOUS HINGES



MODERN design calls for Continuous Hinges, which permit flush fitting for improved appearance and security. Wagner has developed special machines and methods for producing Continuous Hinges fast and economically in any metal — any length, width and finish. Engineered to your specific requirements, they can be perforated, counter sunk, formed or spring loaded.

You'll find Wagner a *dependable source* for Continuous Hinges of any kind. For your present or future products, we'll work with you confidentially. Write today.

E. R. WAGNER MFG. COMPANY

4619 North 32nd Street • Milwaukee 9, Wisconsin

Since 1899 producers of Metal Stampings and Specialties, Hinges and Hardware, Machine-Applied Hinges, Rolled Butt-Joint Spacers and Bushings.

HANSEN *Couplings*

PACE PRODUCTION IN THE GREAT LOCKHEED PLANT!

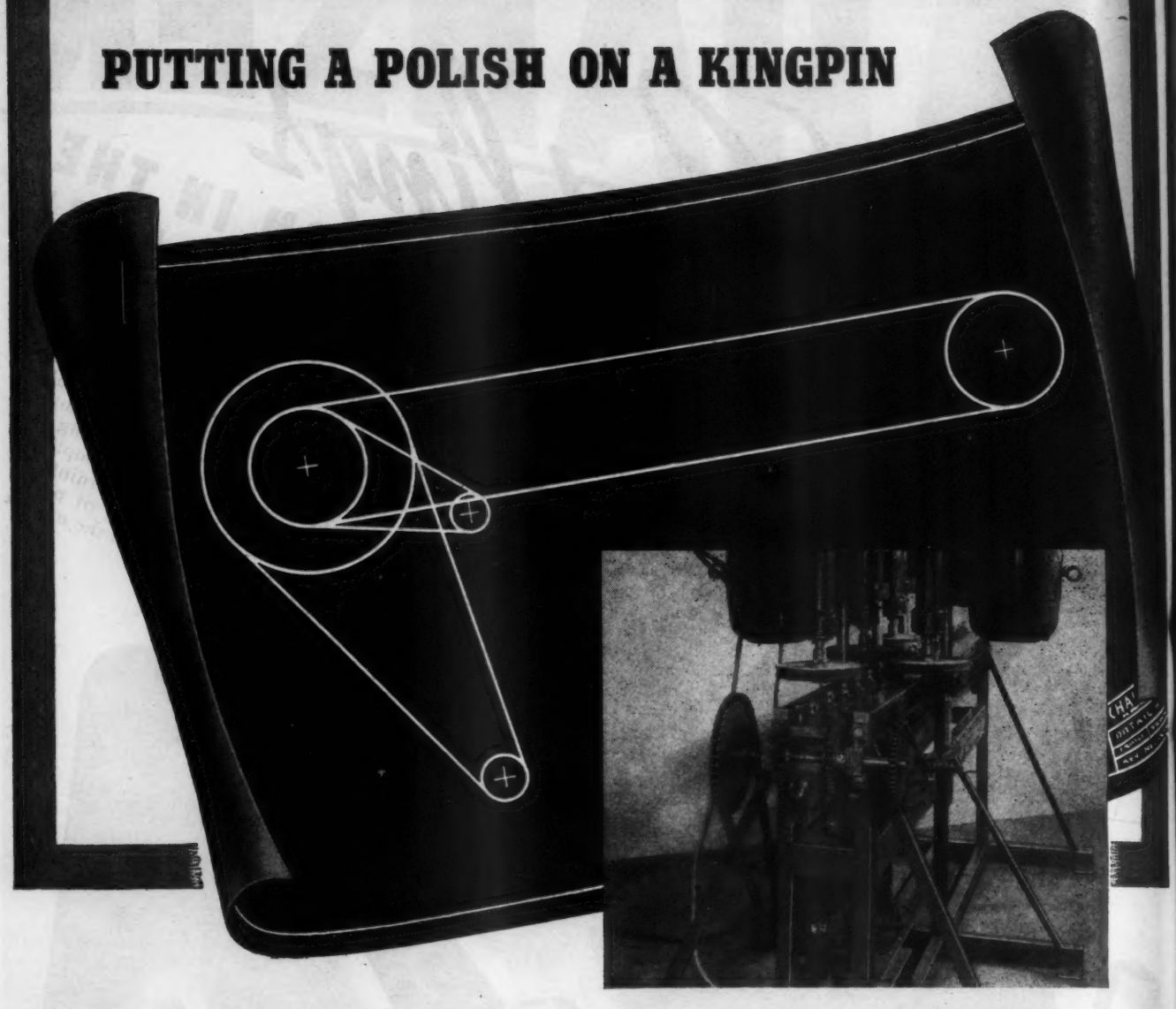
The remarkable production records made in the great Lockheed plant are something to be proud of because here is peak production at low operating expense. ● Hansen couplings used throughout the Lockheed plant are a very important factor in piling up production records on the great Lockheed Lightning and the giant transport Constellation. ● With Hansen couplings it's speed, ease of operation, no wastage of time and no leakage which means a big savings in air. ● Hansen couplings are easy to operate; slight push of plug into socket, coupling connected, air is automatically turned on. Easy pull on sleeve, coupling is disconnected, air is automatically turned off. No twisting, coupling locking; no kinking of hose and no jamming or freezing of parts. ● Hansen couplings are the most widely used couplings on the market due to their vastly superior performance and long life.

Write for free industrial catalog.

HANSEN MANUFACTURING CO.

1786 EAST 27th STREET • CLEVELAND, OHIO

PUTTING A POLISH ON A KINGPIN



Spinning and whirling their way past the buffers, 8000 kingpins an hour move through this straight line polishing machine. Rough spots are removed . . . the pins get a high polish and the whole operation moves along smoothly and easily, for Baldwin Roller chain belts are on the job.

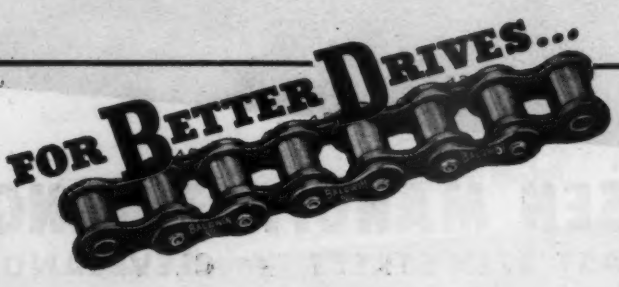
TRANSMITTING the power to the conveyor and to the spinner, driving the conveyor and spinning the pins, Baldwin Roller chain belts play a big part in the successful operation of this polisher. For the positive grip of the chain on sprocket teeth assures smooth operation, accurate timing and no loss of power regardless of adjustment.

The ability of Baldwin Roller chain belts to absorb shock loads . . . their low maintenance and quiet operation . . . their efficiency in transmitting power, timing operations and conveying materials make them ideal for all types of machines . . . in every industry.

BALDWIN ROLLER CHAIN BELTS OFFER YOU THESE ADVANTAGES:

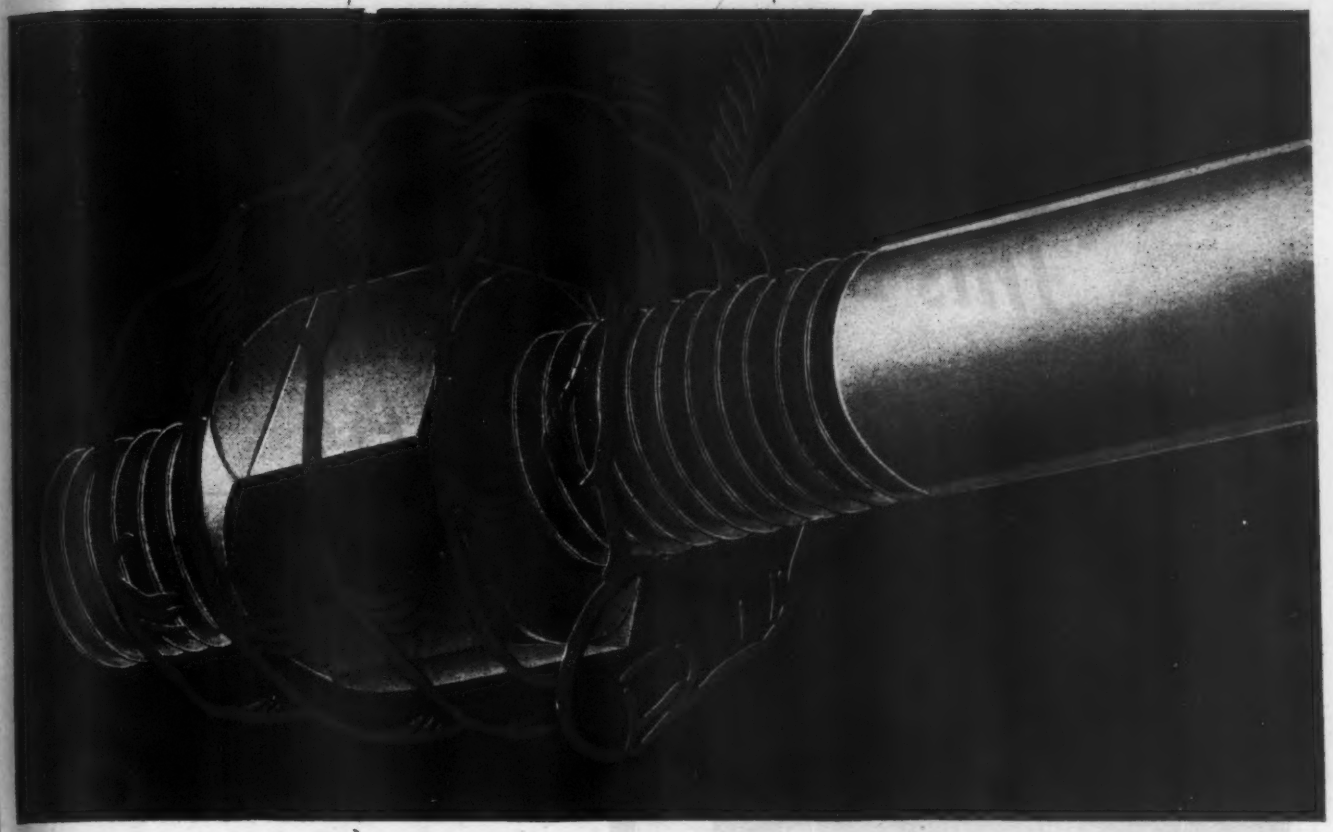
1. **Compact—transmit more horsepower in equal space.**
2. **Allow variation in shaft settings . . . not dependent on set distances between centers for effective and proper operation.**
3. **Simplicity of installation . . . chain easily detachable.**
4. **No pre-load to shorten bearing life . . . not installed under tension.**
5. **Quiet in operation . . . do not create vibration.**

For complete information on Baldwin Roller chain belts, call your Baldwin Man or write for your copy of Catalog M. Baldwin-Duckworth Division of Chain Belt Company, 321 Plainfield Street, Springfield 2, Mass.

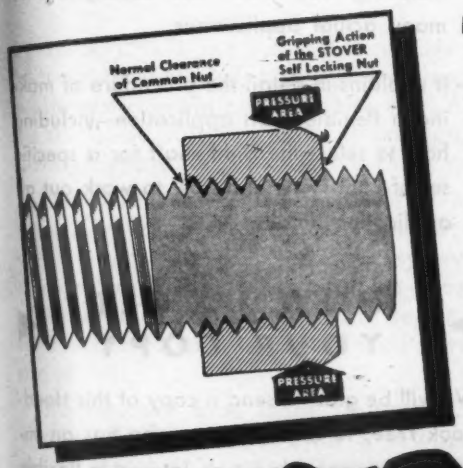


BALDWIN

ROLLER CHAIN BELTS



IT'S THE VIBRATION-DEFYING GRIP THAT COUNTS



The illustration above shows a cross section of an ordinary bolt on which a STOVER Self-locking Nut has been screwed. Note how the tapered threaded section of the nut grips the bolt, thereby giving it maximum vibration resistance.

THE GRIP of the Stover Self-locking Nut is supplied *by the nut itself.* It is the grip *of metal on metal.* It derives its power from the elasticity of its own metal for it is in one piece with no complicated assembly.

Examination will reveal that the Stover Self-locking Nut is no ordinary nut. Indeed it is a product of exceptional precision. No less than sixteen precision machines are employed in its manufacture and inspection.

Today it is eliminating the loosening effect of vibration on many types of war machines. Tomorrow it will do the same thing for machines of peace. Are you interested?

Send for descriptive literature and samples.

STOVER
SELF-LOCKING NUT
"IT WON'T SHAKE LOOSE"

- meets Army and Navy Specifications
- does the whole job by itself
- locks at any point desired on the bolt
- does no harm to bolt threads
- can be used over and over without substantial loss of efficiency
- made in standard sizes and threads from ¼ inch to 1 inch
- costs no more than older-type less efficient lock nuts

STOVER LOCK NUT AND MACHINERY CORPORATION

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FREE - TO ENGINEERS

This 256-Page Handbook on FLEXIBLE SHAFTS

RIGHT OFF THE PRESS this Handbook completely covers the subject of flexible shafts.

— It presents full information and engineering data on the two classes of flexible shafts—power transmission and remote control.

— It gives a clear picture of the range and scope of available shafts of each class—including illustrations and descriptions of many actual applications.

— It explains in detail the procedure of making a flexible shaft application—including how to select the right shaft for a specific set of conditions and how to work out all application details.

▶ HOW TO GET YOUR COPY ◀

We will be glad to send a copy of this Handbook *free*, to any engineer who has an immediate, or possible future, interest in flexible shafts. We make only this understandable provision — that you write for your copy on your business letterhead and indicate your position or title.

ARMY E NAVY

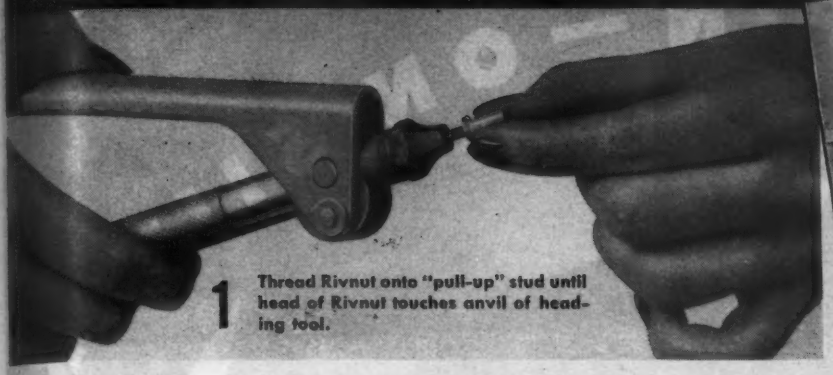
S.S.WHITE INDUSTRIAL DIVISION

THE S. S. WHITE DENTAL MFG. CO.

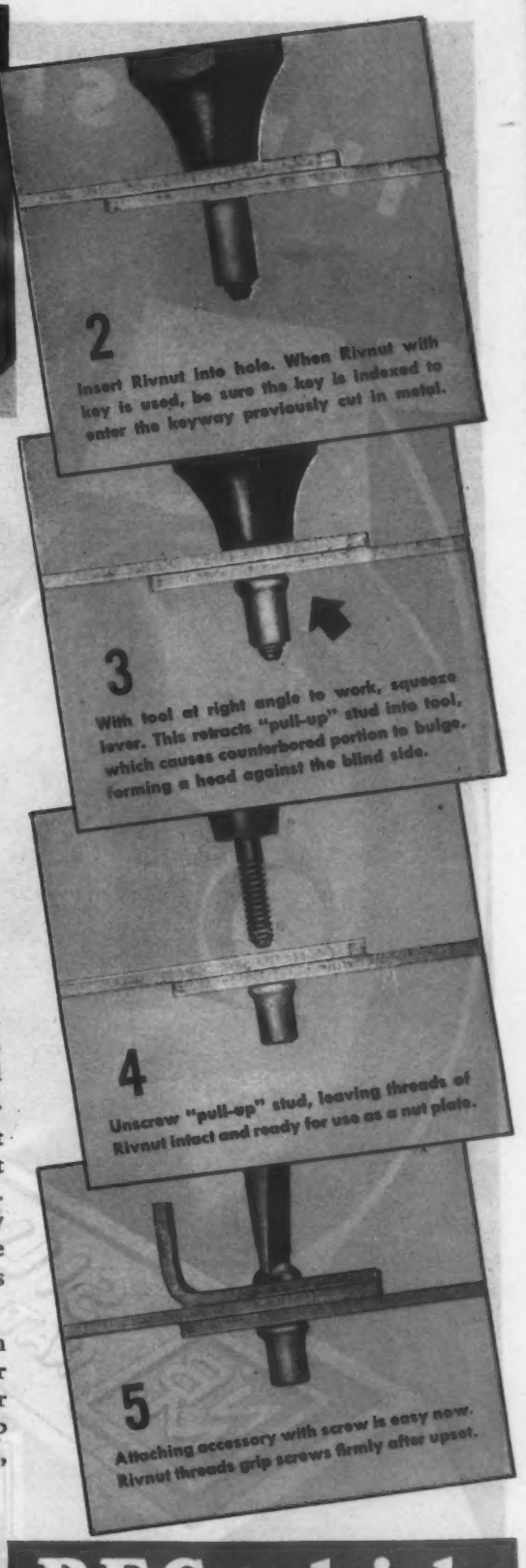
DEPT. D 10 EAST 40th ST., NEW YORK 16, N. Y.

FLEXIBLE SHAFTS — AIRCRAFT ACCESSORIES
MOLDED PLASTICS
MOLDED RESISTORS — FLEXIBLE SHAFT TOOLS

HERE'S HOW RIVNUT WORKS



1 Thread Rivnut onto "pull-up" stud until head of Rivnut touches anvil of heading tool.


2
Insert Rivnut into hole. When Rivnut with key is used, be sure the key is indexed to enter the keyway previously cut in metal.
3
With tool at right angle to work, squeeze lever. This retracts "pull-up" stud into tool, which causes counterbored portion to bulge, forming a head against the blind side.
4
Unscrew "pull-up" stud, leaving threads of Rivnut intact and ready for use as a nut plate.
5
Attaching accessory with screw is easy now. Rivnut threads grip screws firmly after upset.

NEW RIVNUT MAKES TOUGH FASTENING PROBLEMS EASY!

Used as *Blind Rivet* . . . as *Nut Plate* for attachment... or both at once!

THE RIVNUT is a one-piece tubular rivet, counterbored and internally threaded. It is upset with an easily operated hand tool while working entirely from one side. A circumferential bulge forms on the blind side that is large enough to prevent its being pulled through metal or plastic even under conditions of eccentric load.

For either use—as a blind rivet or as a nut plate for attachment—the Rivnut has important advantages: One-piece design keeps cost down—makes installation so easy, even a blind man can do it. Rivnuts are light, strong, compact—ready for use as received. They have an unusually wide bearing surface, yet require a smaller hole than other blind fasteners. Keyed Rivnuts are available for use as nut plates.

Rivnuts are now made of both corrosion-resistant aluminum alloy and brass. In addition, a new *splined* Rivnut is available for use in wood or plastics. If special-purpose Rivnuts are needed for your particular application, our engineers will be glad to work up special designs for you. The B. F. Goodrich Company, Dept. 103, Akron, Ohio.

FREE . . . NEW "RIVNUT DATA" BOOKLET

Get the whole step-by-step story of Rivnut installation; facts on Rivnut types, sizes, grip-ranges, etc. Just write to The B. F. Goodrich Company, Department 103, Akron, Ohio.

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RIVNUT

IT'S A RIVET...IT'S A NUT PLATE

THEY SPIN—ON SILVER

7 things looked bad in '42. Without tin, wheels couldn't spin—we couldn't win.

Then N-B-M brought out Silver Babbitt to help break the bearing bottleneck. After two years of brutal punishment N-B-M Silver Babbitt has proved itself equal to tin-base Babbitts on every count.

You can be sure of satisfactory service when you specify

N·B·M
SILVER BABBITT

Write for our engineering briefs.

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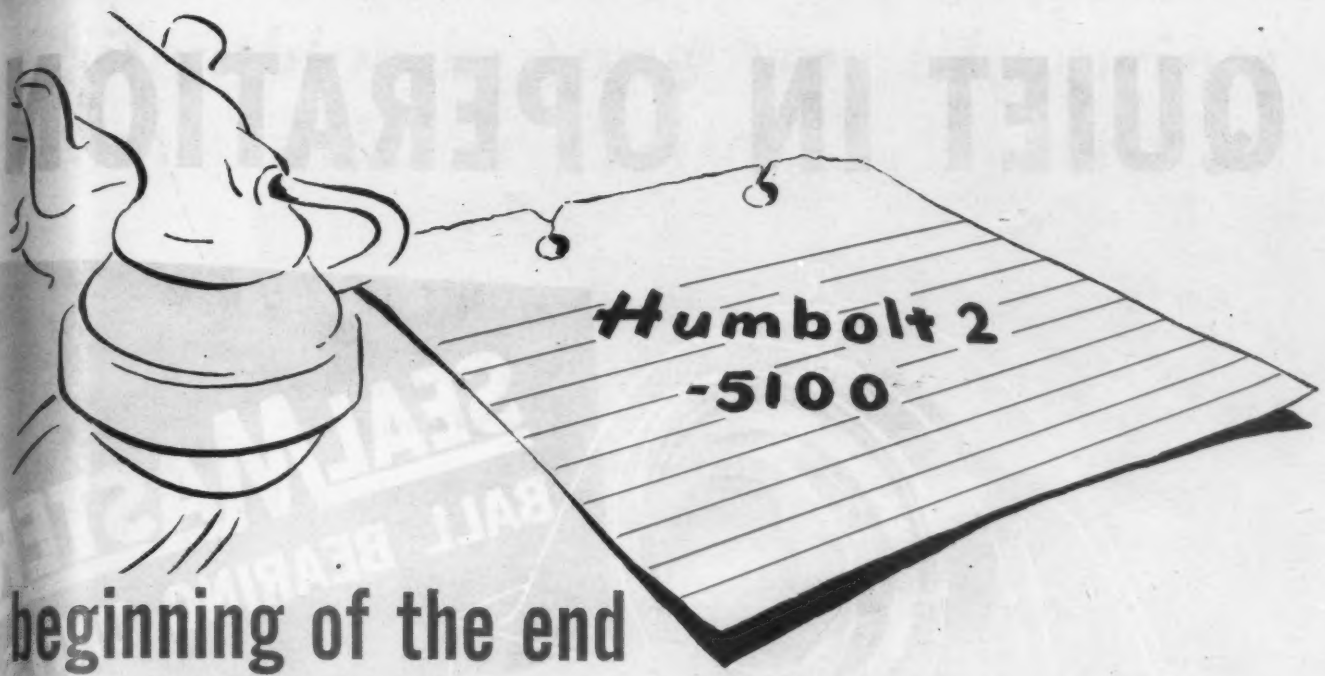

beginning of the end for product headaches

In a brief telephone call you can arrange for a meeting to discuss Foote, Pierson contract manufacturing service. By making it, you may be taking the first step in ending a troublesome production headache.

For, without obligation on your part, a frank face-to-face conversation with Foote, Pierson technical men may provide an answer you're looking for . . . may show you how to get—*economically*—the extra product or the extra component you need.

Even before you talk things over, keep in mind these facts about Foote, Pierson & Co. It has been in contract manufacturing most of its 48 years in business. It has machines and tools and the manpower and technicians to lick tough present day schedules. Top to bottom, its personnel brings to your problems ingenuity, skill and a sense of loyal responsibility.

F-P service can start as far back as planning, engineering and design. It can include metal-forming and fabricating operations. It can extend to plating and finishing a product or a product's component. It can follow through all the way from assembling, inspecting and packaging to the shipment by rail, water or air freight from the company's uniquely favorable location in Newark, which includes storage warehouse facilities.

Why not 'phone HUmbolt 2-5100 now and make an appointment?

"like adding a wing to your plant"

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MANUFACTURERS OF PRECISION INSTRUMENTS SINCE 1896

75 Hudson Street Newark 4, N. J.

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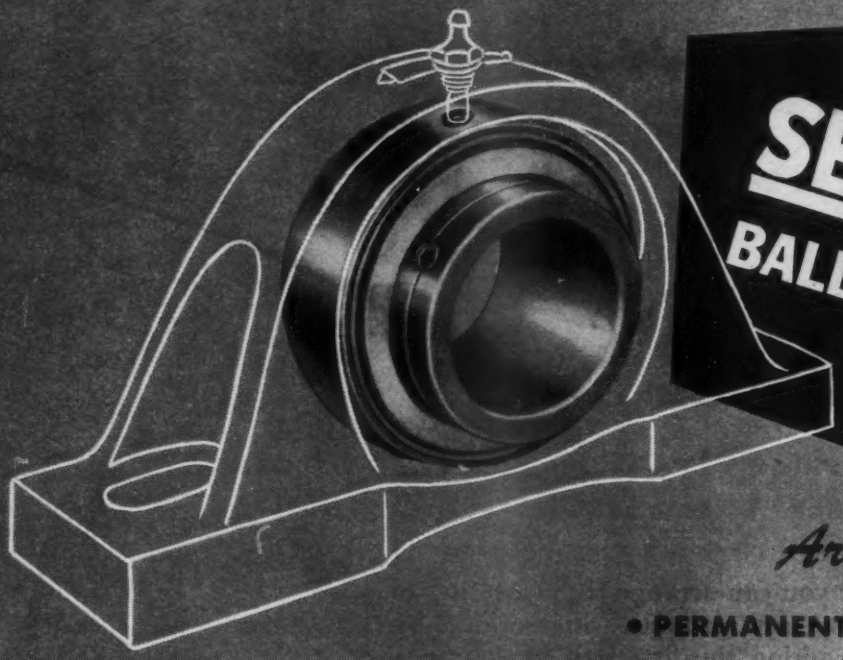
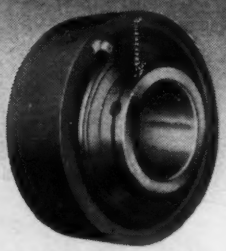


SEALMASTER BALL BEARING UNITS

Are Also

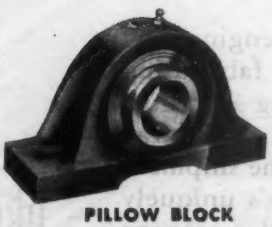
- **PERMANENTLY SEALED**
- **SELF-ALIGNING**
- **PRE-LUBRICATED**



CARTRIDGE UNIT

FLANGE UNIT

FLANGE CARTRIDGE UNIT



PILLOW BLOCK

SealMaster design and construction produces a bearing unusually quiet in operation.

The patented, *permanent seal* effectively keeps out dirt and retains lubricant.

SealMasters are *self-aligning* . . . mis-alignment of the shaft cannot distort the seal.

The outer race of the bearing is locked against rotation in the housing by a patented locking pin.

All SealMaster ball bearing units are *pre-lubricated* at the factory, and reach you ready for immediate service.

These important features assure long bearing life and satisfactory performance for users of SealMaster Ball Bearing Units. *Write for Catalog No. 840 which contains dimensions, load ratings and engineering data on the complete SealMaster line.*

BEARING DIVISION

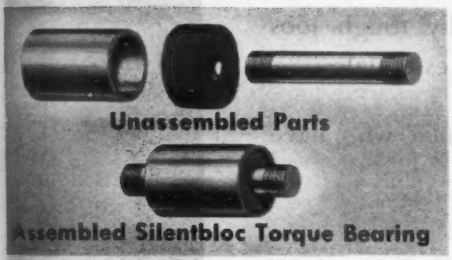
STEPHEN S-A DAMSON MFG. CO.

9 RIDGEWAY AVENUE, AURORA, ILLINOIS ★ LOS ANGELES, CALIF. ★ BELLEVILLE, ONT.

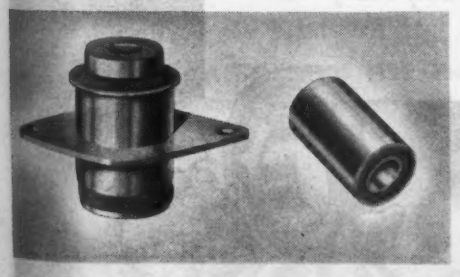
Factory Representatives and Dealers in All Principal Cities

Silentbloc in Your New Blueprints Means a Better Product...Lower Costs

Silentbloc Rubber Mounting above is used to damp or isolate vibration and cushion shock loads in motors and other moving equipment.



PATENTED CONSTRUCTION gives engineered performance. Silentbloc consists of outer metal sleeve into which rubber ring is forced under high pressure and inner shaft, "shot" through rubber. Radial compressive force of elongated rubber forms indestructible rubber-to-metal union.



SILENTBLOC Mounting gives engineered control of vibration in motors and moving equipment, cushions shock loads, absorbs noise.

SILENTBLOC Bushing corrects for misalignment of hinges, shafts, bearings. Improves operation, cuts machining and fitting costs.

BEFORE you approve any blueprint, check the improvements you might make with General Silentbloc mountings, bearings and bushings.

If you have a problem of vibration, shock load or noise, a Silentbloc mounting can be engineered for your specific needs.

If your equipment has oscillating parts, a Silentbloc rubber torque bearing can simplify construction and give trouble-free operation without lubricants.

You can improve performance and cut production costs with Silentbloc rubber bushings that correct for misalignment of shaft supports or bearings.

General Silentbloc parts can be made any size, to carry loads of ounces to tons, using any kind of metal and rubber. Skilled General engineers can design a Silentbloc to give the exact performance you specify.

Silentbloc has been proved in use on automotive, industrial, marine and home machinery, electrical equipment, aircraft and other products. *Silentbloc belongs in your new-product blueprints.*

It Will Pay You to Know More About Silentbloc

For factual booklet, write The General Tire & Rubber Company, Dept. 65, Wabash, Ind.

THE GENERAL TIRE & RUBBER CO.

Mechanical Goods Division, Wabash, Indiana

The GENERAL SILENTBLOC
MOUNTINGS . . . BEARINGS
COUPLINGS

TO HOOVER FOR . . .
QUALITY *and* QUANTITY WAR PRODUCTION

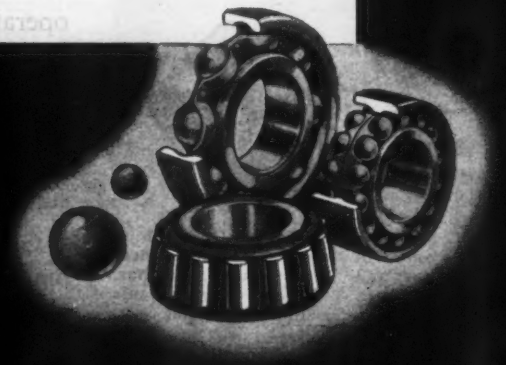
Not Millions — but Billions — not one or two or three — but actually more than THREE BILLION Hoover Products have been supplied for War Equipment.

For use in more than two thousand different types of War Apparatus — from tiny delicate super-precision instruments, to giant Ships — Guns — Tanks — Planes — Machine Tools and Trucks — the really tough jobs where precision and brute strength are essentials.

Hats off to the Hoover Men and Women who have produced more than THREE BILLION

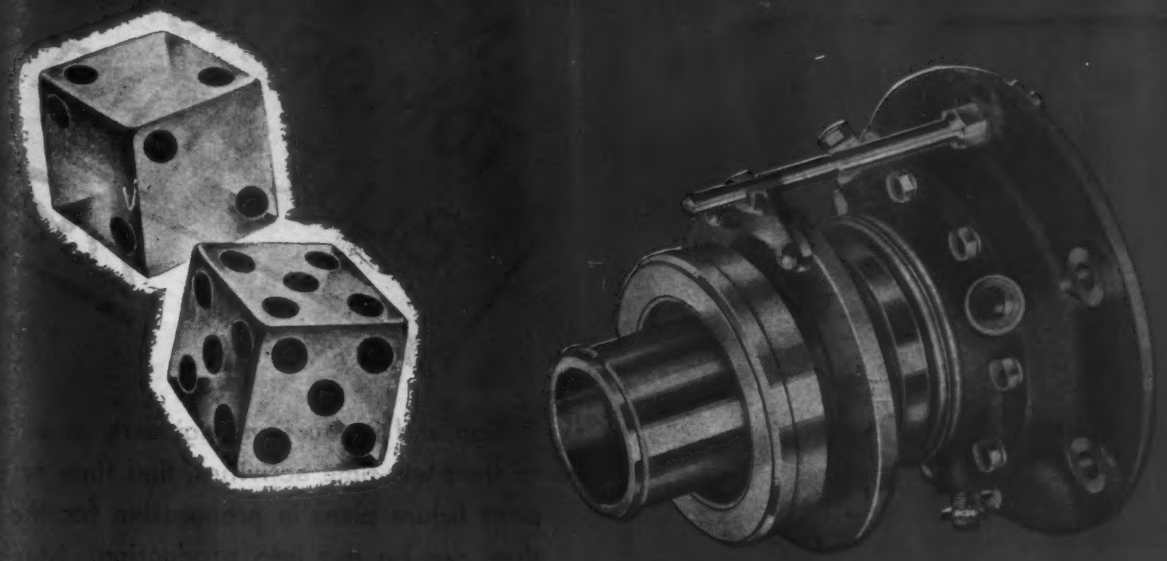
Hoover Ball Bearings
Hoover Balls
Hoover Tapered Roller Bearings

the combination which has earned the Army-Navy "E" Award.



HOOVER
BALL AND BEARING COMPANY
ANN ARBOR, MICHIGAN

NEW PESCO HYDROLEASE



. . a natural any way you look at it

There are many jobs in industry that Pressurized Power by PESCO is just naturally better-fitted to perform.

This is one of them—actuating heavy clutches . . . for industrial power machinery, buses, trucks and heavy motor vehicles.

The *Hydrolease* is one of the new PESCO hydraulic products now made available to industry. It is a compact, precision hydraulic clutch actuator. When installed in the clutches of your machines it eliminates a large number of mechanical parts and points of lubrication. It substantially reduces clutch wear and tear and saves in maintenance costs.

The smooth, positive action of the *Hydrolease*—a distinctive feature of applied hydraulics—engages and disengages a clutch with new ease and more accurate control. It keeps the clutch in constant adjustment.

It will pay you to get complete facts about this new PESCO product. Write for the *Hydrolease* Folder to PESCO Products Company, Industry Service M, 11610 Euclid Avenue, Cleveland 6, Ohio.

ALSO SEND FOR THIS BOOK "Pressurized Power and Controlled Flow by PESCO". This book pictorially tells the story of PESCO equipment, manufacturing facilities and engineering service. A copy will be mailed promptly upon request.

Division Bora-Warner

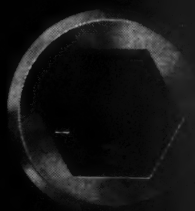
In Precision Hydraulics, Fuel Pumps, Air Pumps, Related Accessories . . .

PERFORMANCE POINTS TO Pesco FIRST

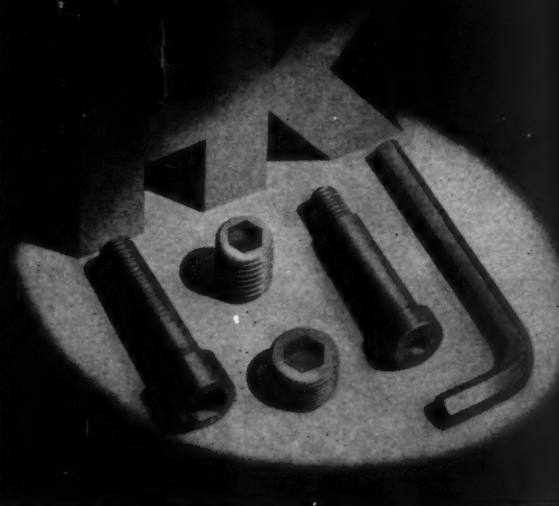
HOLO-KROME

SOCKET HEAD CAP SCREW

SOCKET SET SCREW

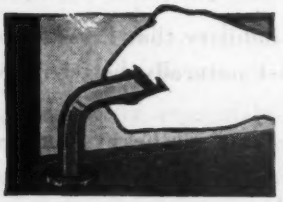


LOOKING INTO THE HOLO-KROME HEX. SOCKET



IN TOMORROW'S BLUEPRINTS *Too!*

Design and Production Engineers, in addition to their war-time activities, find time to blueprint future plans in preparation for the day they can be put into production. Machines and parts which will be required to sustain unusual stresses and vibrations must have their component parts securely fastened. Now is the time to investigate—prepare for tomorrow's production today!



INTERNAL WRENCHING FEATURE • QUICK & POSITIVE TIGHTENING

SOCKET SCREWS

The BETTER Fastening Method

Design and Production Engineers find the assistance given by Holo-Krome Fastening Engineers extremely valuable in planning their production schedules. Holo-Krome FIBRO FORGED Socket Screws, Completely Cold Forged by the Holo-Krome patented method, do the job for which they are intended with Guaranteed Unfailing Performance.

CATALOG OF HOLO-KROME PRODUCTS GLADLY SENT

HOLO-KROME

fibro-forged **SOCKET SCREWS**

Manufactured Exclusively by

THE HOLO-KROME SCREW CORP.
HARTFORD 10, CONNECTICUT, U. S. A.

POWER THAT OBEYS A TWIST OF THE WRIST

Oilgear generator (pump) which supplies fluid power to an Oilgear motor for traversing turrets in all tanks mentioned and many others. These Oilgear systems provide high traverse speed, exceptionally accurate control and dependability.

Oilgear's EAGER RESPONSIVENESS MAY WIN A POSTWAR BATTLE FOR YOU

Alert and forward-looking "peace" machine designers and users are finding new paths to efficiency by watching the performance of machines of war . . . at war. Take for example, America's newest M3 and M5 light tanks and M4 mediums. Here, in all these, is power at the twist of a wrist, supplied by Oilgear Fluid Power systems, to enable the gunner to traverse and train the turret (and guns) on the target, quickly, accurately and without effort. He gets extreme speed instantaneously when searching out a new target. He gets extreme deceleration when he has found it, and low tracking speed as he trains his gun on the moving target or when he is moving past a stationary target.

In brief, he has instantaneous torque, extreme range of speed, steplessly variable speed from zero to maximum and return. He has tremendous power in small compass. He has absolute control over power and speed, in this case, from a simple handle which he twists from side to side. Whether *you* need *these* Oilgear characteristics or a combination of scores of other functions to improve a machine, better its operation or solve a hitherto "impossible" problem, write and ask Oilgear engineers for their recommendations. There is no obligation of course. . . . THE OILGEAR COMPANY, 1311 West Bruce Street, Milwaukee 4, Wisconsin.

ARE YOU TRYING TO:

1. Apply large forces through long . . . or short . . . strokes at variable speeds?
2. Obtain automatic work cycles, variable speeds in either direction . . . with or without pre-set time dwell?
3. Apply large forces through continuous or intermittent reciprocating cycles at constant or variable velocities?
4. Obtain extremely accurate control of either position or speed of a reciprocating member?
5. Apply accurately variable pressure either static or in motion?
6. Closely synchronize various motions, operations or functions?
7. Apply light . . . or heavy . . . forces at extremely high velocities through either long or short distances of travel?
8. Obtain continuous automatic reversing drives at constant R. P. M. or over a wide range of speed variation?
9. Obtain accurate remote control of speed and direction of rotation, rates of acceleration and/or deceleration?
10. Obtain constant horsepower output through all or part of a speed range?
11. Obtain automatic torque control?
12. Obtain accurately matched speed of various rotating elements?
13. Obtain constant speed output from a variable speed input?
14. Obtain full pre-set automatic control, elimination of problems of shock, vibration, etc.?

You Need Oilgear!

OILGEAR

Fluid Power

THERE'S NO SUCH WORD AS "CANT"

WHEN YOU USE TWIN-FAST SCREWS

Twin-Fast's balanced construction, uniform shank, and single centered point assure straight driving —far neater fastenings!

Three basic improvements are responsible for Twin-Fast's neater fastenings. 1. *Uniform shank* from first to billionth! Made with a one-piece rather than a two-piece die, Twin-Fast's shank is never distorted — therefore never throws the screw on a slant. 2. Twin threads which spiral the root from opposite sides give the Twin-Fast Screw symmetrical *balanced construction* for balanced driving—straight driving. 3. Twin-Fast's *single centered point* — at the axial center of the screw — bites into the wood at first pressure. Provides fast, straight starts. Eliminates danger of cant.

Avoid delays — cut production costs and fastening time with Twin-Fast Screws. Write for literature and samples *today*.

OTHER TWIN-FAST FEATURES

Twin, parallel threads provide twice the thread pitch of ordinary screws. *Driving time and costs are cut in half!*

Relieved shank diameter prevents stresses which might cause immediate or eventual splitting or fissures and weakened seating.

Cylindrical construction (not tapered) increases thread area for tighter seating, greater holding power. Often, fewer and shorter screws may be used.

Twin-Fast Screws come in steel or brass with round, flat, or oval heads —standard sizes and thread count.

BY ALL MEANS BUY BONDS!

FOR FASTER PRODUCTION—STRONGER CONSTRUCTION

TWIN fast

REG. U.S. PAT. OFF.

TWIN THREAD WOOD SCREWS

PATENTS 2,314,390; 2,314,391; OTHER PATS. PENDING

The Blake & Johnson Company makes many thousands of different types of fastening devices in all standard metals.

THE BLAKE & JOHNSON COMPANY SINCE 1849

WATERVILLE, CONNECTICUT

PN
CABLE TERMINALS
JUNCTION BOXES
CONDUIT FITTINGS
PN
POULSEN
&
NARDON
INC.
Terminal Box 2398
Los Angeles 54, Calif.
AIRCRAFT PARTS & FITTINGS
Fuel and oil shells, screw machine products and stampings of all types.
Additional Data available to Industry Personnel.

"MAXITORQ"

FLOATING DISC CLUTCH

NO DRAG - NO ABRASION - NO HEATING

WINS APPROVAL OF LEADERS IN MACHINE TOOL MANUFACTURE

Machine tool operation is only as effective as the power transmission equipment permits . . . which means smooth engagement of the clutch, quiet, cool running and positive disengagement. That the "Maxitorq" has been selected by many leading machine tool builders is a tribute to its dependability under constant operation.

The reasons for such approval are:

1. Assembly, adjustment, take apart . . . without the use of tools . . . easily, quickly.

2. Floating Discs . . . which ride free in neutral . . . kept apart by Maxitorq Separator Springs . . . "you can see between them". This prevents drag and the consequent abrasion and heat.

3. Discs which have flat, true surfaces . . . accurate duplication of all disc thicknesses. This means no high or low spots under engagement . . . the entire surface area being engaged, with contact evenly distributed. Obviously clutch service life is greatly extended.

4. Adjustments for spring tension are quickly made by means of knurled ring, locked with a spring and notched retaining ring, to a proper setting. Again . . . no tools required.

Check these important advantages . . . they will insure better operation of all machinery where smooth power pick up and quick, positive disengaging are essential.

This is the single and at top is the double "Maxitorq" clutch, both of which are available in Dry or Wet types. Pulley and Cut-off Coupling types also made. Capacities from ¼ to 5 H.P. at 100 R.P.M. Information about larger capacities on request.

SEND FOR NEW CATALOG No. 4

THE CARLYLE JOHNSON MACHINE COMPANY
MANCHESTER, CONNECTICUT

Scaife Air Tanks

help service America's Clipper Ships at home and abroad

Among many time-saving devices used by Pan-American Airways is the mobile compressed air outfit illustrated above—equipped with a Scaife air-receiver.

If your present or future plans call for the use of cylindrical products or containers for gases, air, water and other liquids, we will be glad to show you how our experience with products of this type may be of real help to you.

SCAIFE COMPANY

FOUNDED 1802

OAKMONT (Pittsburgh District), PA.

Representatives in Principal Cities

MARLIN-ROCKWELL CORPORATION Executive Offices: JAMESTOWN, N. Y.

Picture This POPE PRECISION SPINDLE *on Your* MACHINES

This POPE Vertical Motorized Spindle with *sealed lubrication*, totally enclosed, fan cooled motor and super-precision bearings means *better work and more of it.*

The coolant is fed down through the hollow spindle, cooling motor and bearings on its way to the inside of the cup wheel where it is most effective for cooling the work.

This Spindle, like all POPE Precision Grinder Spindles, will give you more production and finer finishes. Ask us to send you Data Sheet P from which we can furnish recommendations and estimates.

POPE Vertical Spindles are available with 3, 5, 7½ or 10 HP Motor. Speed may be 600, 750, 900, 1200, 1800 or 3600 RPM, 60 cycle AC current. Even higher speeds are attainable with frequency changers.

POPE Vertical Motorized Spindles are used not only for surface grinders but for a variety of other purposes. Where working loads are largely radial, bearings are arranged to take care of them.

POPE

REG. U.S. PAT. OFF.

POPE MACHINERY CORPORATION

ESTABLISHED 1920

261 RIVER STREET • HAVERHILL, MASSACHUSETTS

BUILDERS OF PRECISION SPINDLES

fluid power flows

THROUGH THIS VITAL LINK

Engineered by PARKER

Fluid Power, the modern way to get things done, is carried wherever you want it to go through tubes, and controlled by valves.

You think of Fluid Power as a three-link chain; Source—Circuit—Utilization.

The ***key link*** is the Circuit—straight line, around corners, into tight places, under direct or remote control. That ***key link*** is vital, for the successful operation of any Fluid Power application depends on it!

It's Parker's business to engineer this vital link—to design it, build it, install it—to build the precision valves and fittings that make it function, and the tools to handle them. We've been at it for twenty years.

A Parker Fluid Power engineer will gladly discuss these interesting ideas with you. Write to The Parker Appliance Company, 17325 Euclid Avenue, Cleveland 12, Ohio.

THE PARKER COUPLING

is the key to the vital link, engineered and designed by Parker—protected against leakage and vibration, precision-made, quick to install, quick to service.

A. A. F. SURPLUS WAR STOCKS

Parker has been selected by Metals Reserve Company to market surplus A. A. F. war stocks of valves and fittings. Immediate delivery assured. For specifications and for installation recommendations, write, wire or phone.

PARKER SERVICE AGENCY
Division of
THE PARKER APPLIANCE COMPANY
Cleveland 12, Ohio, U. S. A.
Agent for
METALS RESERVE COMPANY

PARKER
APPLIANCE COMPANY
CLEVELAND • LOS ANGELES
FLUID POWER ENGINEERING

UP A TREE

because the tracing papers you use just won't stand up under frequent corrections or constant handling?

PUT A BEE

in your boss's bonnet to give tracing papers the old heave-ho, and to switch to tracing cloths . . . *Arkwright Tracing Cloths!*

YOU'LL SOON SEE

that frequent corrections and constant handling don't hurt Arkwright Tracing Cloths a bit. In the long run, you'll also see they cost no more than tracing papers. Arkwright Finishing Company, Providence, R. I.

Sold by leading drawing material dealers everywhere

Arkwright
TRACING CLOTHS
AMERICA'S STANDARD FOR OVER 20 YEARS

Another

ROMEC

WATER INJECTION

PUMP

For Sudden Surge in Speed

ROMEC AIRCRAFT PRODUCTS

This pump gives the plane extra reserve power to be used in any emergency. It makes possible a sudden burst of speed for quick get-away or faster dash when needed.

The RD-7900 Water Injection Pump can be used to supply water or water-alcohol mixtures, at pressures of 45 P.S.I. up to 250 G.P.H. The pump meets the mounting dimensions of the 400 G.P.H. Fuel Pump of Army-Navy Specification AN-P-52.

Monel metal rotor and liner. Bearings and blades of Graphitar No. 2. Low temperature diaphragm and seal. High performance relief valve balanced to supercharger pressure. Adapted to installations using the turbo supercharger. Non-corrosive throughout. 24 Volt D.C. explosion-proof Delco motor, light weight with geared head and glass insulated. It's a near miracle in mechanical performance. Write for details.

ROMEC PUMP COMPANY

100 ABBEY ROAD ELYRIA, OHIO

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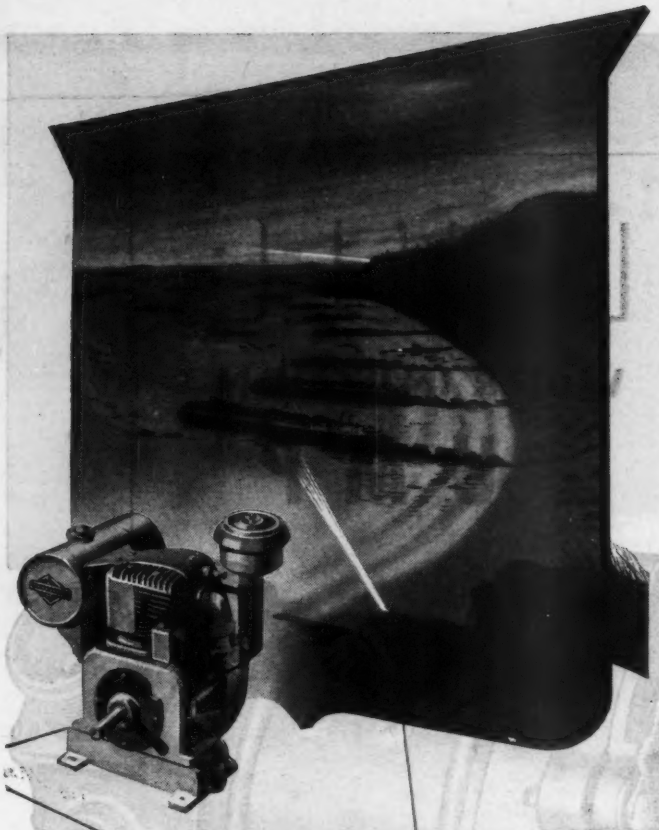


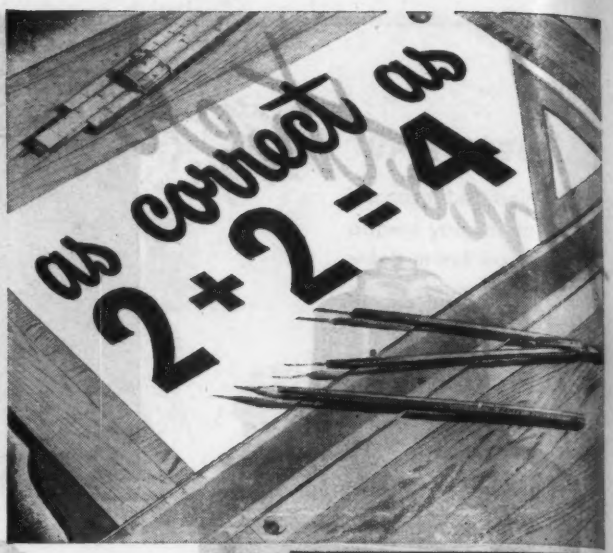
Guiding Fingers of Light

From newly established positions, portable beacon units guide and warn supporting ships and aircraft. Their electric generating plants are powered by rugged, quick-starting Briggs & Stratton engines —another one of many vital war services by hundreds of thousands of Briggs & Stratton engines.

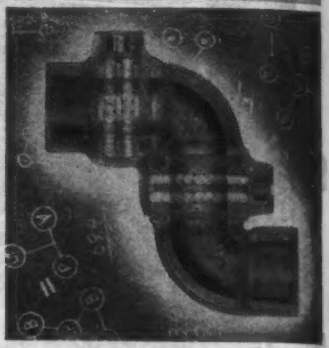
Air-Cooled Power

4 CYCLE BRIGGS & STRATTON GASOLINE ENGINES

Briggs & Stratton leadership in design, engineering and precision manufacture is backed by the performance record of more than TWO MILLION Briggs & Stratton engines—and a quarter-century of *continuous* production of *"air-cooled power."* You can profit by this experience in your plans for the future —whether you manufacture, sell or use power equipment. BRIGGS & STRATTON CORP., Milwaukee 1, Wis., U.S.A.



CHIKSAN FORMULA FOR A *Perfect* SWIVEL JOINT



$$BB_2 + EP = \frac{LT}{P/V}$$

BB_2 = Double rows of Ball Bearings — For easy turning with minimum friction. They also maintain perfect alignment of moving parts.

EP = Effective Pack-Off — This self-adjusting unit permits the use of the same Swivel Joint for all services. Nothing to tighten or adjust.

LT = Low Torque — No excessive friction drag because turning takes place on ball bearings which hold moving members together. Tightness of Joint does not depend upon compressing packing element by means of bolted flanges, thereby causing joint to stick.

P/V = Pressure or Vacuum — Pre-determined pressure on Packing Ring prevents leaks due to pressure or vacuum. Packing automatically adjusts itself to either service.

These are the essential elements for perfect swivel action. You get ALL of them when you specify Chiksan Ball-Bearing Swivel Joints.

WRITE FOR CATALOG AND ENGINEERING DATA

CHIKSAN TOOL COMPANY

CHIKSAN TRADE MARK REG.

Ball Bearing SWIVEL JOINTS for ALL PURPOSES

BREA, CALIFORNIA

"MADE BY NATIONAL SCREW" means *Quality Control*

Bench inspection.

Inspection under magnifying glass.

1944 outlining procedures to be followed in establishing Quality Control Rating for the National Screw & Mfg. Company. The Air Technical Service Command is pleased to advise that Quality Control procedures at your facility are such as to warrant approval. Therefore, the National Screw & Mfg. Company has been listed on the Army Air Forces records as a Quality Control "APPROVED" facility.

Checking pitch diameters with roller snap gauges.

Magnetic inspection by Magnaflux machine.

As a principal source of supply for aircraft fasteners, we have developed facilities for achieving tolerances formerly unheard of in bolts, nuts and screws.

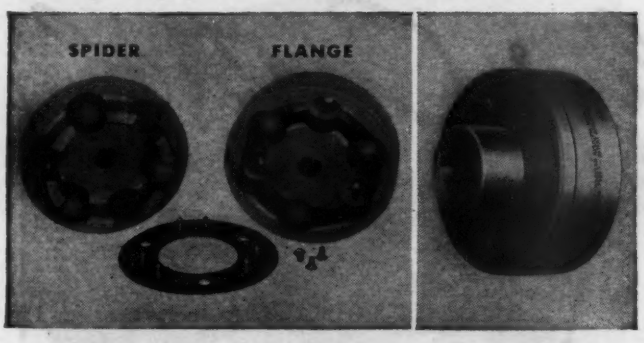
There is only one way to insure rigid adherence to the quality required by the Air Forces, with a production of millions of parts daily. That is by a system of inspection that is complete and foolproof.

The excerpt reproduced above from a recent letter of formal approval from the Air Technical Service Command indicates how well National Screw has achieved this goal.

National HEADED AND THREADED PRODUCTS

THE NATIONAL SCREW & MFG. CO., CLEVELAND 4, O.

Simplify assembly with . . .



CUSHIONPOWER
RESILIENT FLEXIBLE COUPLINGS

1—Easy to assemble . . . only a screw driver required.
2—Easy to line up with a straight edge.
3—Easy to disconnect without changing alignment.
4—No lubrication or maintenance required.
5—Absorbs load shocks.
6—Reduces wear in connected machines.
7—Cushions noise and vibration.
8—Trouble-free operation.

► These flexible couplings, made by the makers of Crocker-Wheeler Motors and Generators, are available for every coupling application. The simple, efficient, economical **CUSHIONPOWER** coupling is not only flexible, but resilient.

► The coupling is simple in design, having but four mechanical parts . . . flange, spider, ball retainer ring and balls moulded from a special rubber composition.

► Write for complete information or call our office nearest you . . . see list below.

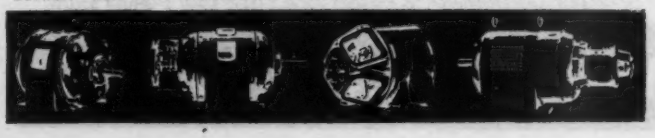
CUSHIONPOWER COUPLING INFORMATION

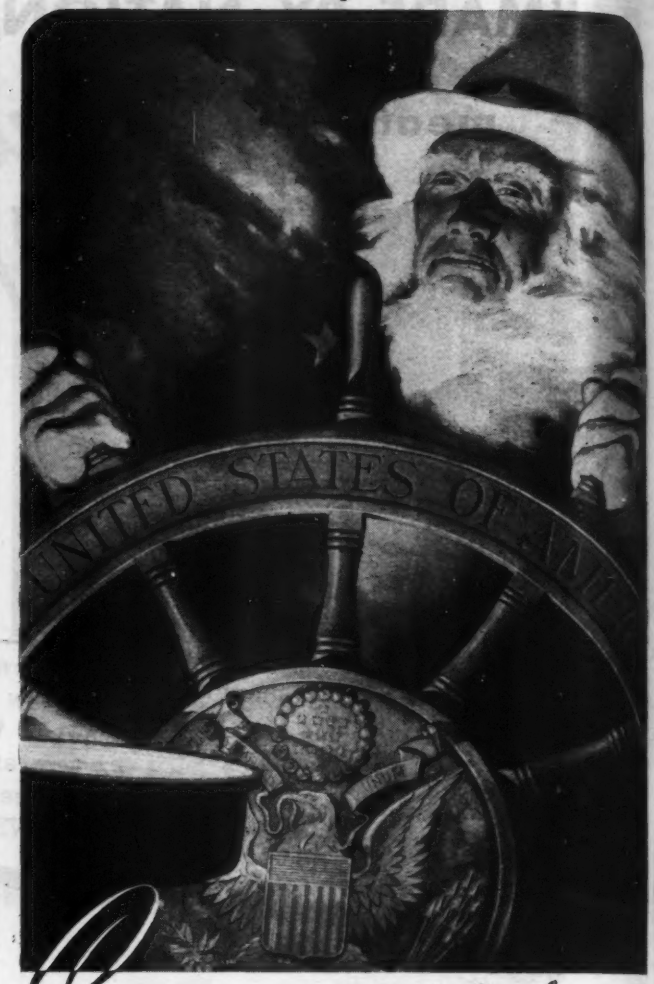
Coupling Size	*H. P. Per 100 R. P. M.	Max. R. P. M.	Max. Bore Spider	Max. Bore Flange	Min. Bore	Net Wt. Lbs.
6	½	7000	¾	1¼	½	3
9	1¼	5000	1¼	1½	¾	6
10	1	7000	1¼	1¼	½	4
11	2½	4000	1⅜	2	⅞	12
16	5	3200	2	2½	1⅛	25
19	11	2600	2⅜	3	1½	40
21	14	2300	2⅜	3¼	1¾	65
25	20	2100	3⅛	4	2	90
27	25	2000	3⅜	4½	2¼	110
31	35	1800	3⅞	5	2½	170
35	55	1550	4½	5½	2½	300

** Use for all applications . . . no service factor necessary.*

JOSHUA HENDY IRON WORKS
CROCKER-WHEELER DIVISION
AMPERE, NEW JERSEY

BOSTON • BUFFALO • CHICAGO • CINCINNATI • CLEVELAND • LOS ANGELES
DETROIT • NEW YORK • PHILADELPHIA • PITTSBURGH • SAN FRANCISCO • WASHINGTON





Continuing on with Confidence

For the second time in one generation this country is turning the tide of victory in a great war. Abroad, our armed forces have shown what free men can accomplish. At home, free enterprise has proved itself by the tremendous volume of its production.

Acme Aluminum Alloys, Inc., is itself a product of free enterprise. Little known in 1919, it is now among the leaders of its industry. The growth of companies like Acme is proof that the free enterprise system remains vigorous and strong.

Free men and free enterprise are steering this country through a great crisis. Free men and free enterprise can continue on with confidence, whatever the future may bring.

ACME *Aluminum Alloys, Inc.*
Formerly Acme Pattern & Tool Co., Inc.
DAYTON 3, OHIO
PATTERNS • TOOLS • ALUMINUM CASTINGS • ENGINEERING

COMPRESSORS TO SCORCH PILL BOXES

THE SAME "KNOW HOW" MAY HELP YOU FIRE THE "BUGS" OUT OF THAT POST-WAR DESIGN.
Planning to build a compressor into that post-war design? Faced with problems of weight—space—cooling under adverse conditions? Need absolute reliability? Write us. We keep strict confidence.

When the nation called for portable flame-throwing units...to burn Japs out of jungles, or scorch the life out of deadly pill boxes . . . Worthington designed a nitrogen compressor to provide the motive power that sweeps the flame to its target.

It had to be *light, air-cooled, compact,* yet *powerful* and rugged enough to stand the rigors of war. Above all, it had to be *reliable.*

In addition to these 2000 lb. nitrogen compressors for flame-throwers . . . Worthington has designed and built engine-starting compressors for landing craft . . . compressors for air field service trailers . . . for high altitude aircraft oxygen-generating units.

Each involved a design problem. In each case, *the compressors could not fail!*

Worthington is still building vertical compressors for war. Soon, we hope, this war-sharpened Worthington skill with all the variables of compressor design . . . this Worthington dependability, chosen above all to meet the exacting demands of war production . . . will be at *your* service . . . to help you solve your design problems . . . or provide for your plant the best standard vertical compressors money can buy.
Worthington Pump and Machinery Corporation, Harrison, N. J.

AC 4-17

WORTHINGTON *BEHIND THE NAME*

STANDARD PRODUCTS DIVISION

VERTICAL AND RADIAL COMPRESSORS —ONLY PART OF WORTHINGTON'S STANDARD PRODUCTS LINE

What's the OIL PRESSURE?

This Greer Hydraulic Test Machine tells the Navy the answer — checks aircraft hydraulic systems and their components . . . fills and filters oil. Used on aircraft carriers as well as at bases, this outfit must be accurate and dependable. To insure that kind of performance . . . Greer chose Allis-Chalmers power.

Built for endurance, high in torque, Allis-Chalmers engines operate smoothly, for long hours, day after day on toughest applications—whether it's continuous or intermittent service. No matter what your engine problem . . . it will pay you to investigate. There is a unit of suitable size to fit your requirements. Choice of fuels. Service facilities everywhere. Write for full information.

Supplying 24 Max. B.H.P. at 1500 R.P.M., this rugged, B-15 engine provides ample power for driving the Greer Universal Hydraulic Test Machine, manufactured by Greer Hydraulics, Inc., New York, N.Y.

ALLIS-CHALMERS

TRACTOR DIVISION • MILWAUKEE 1, U. S. A.

POWER UNITS

FIVE SIZES

MODEL B-15 — 4 Cylinders, 24 Max. B.H.P. at 1500 R.P.M.
MODEL W-25 — 4 Cylinders, 31.5 Max. B.H.P. at 1300 R.P.M.
MODEL U-40 — 4 Cylinders, 45 Max. B.H.P. at 1200 R.P.M.
MODEL E-60 — 4 Cylinders, 74 Max. B.H.P. at 1050 R.P.M.
MODEL L-90 — 6 Cylinders, 110 Max. B.H.P. at 1050 R.P.M.

WITTEK HOSE CLAMPS For All Applications

The dependability of Wittek Hose Clamps, long accepted by the automotive and aviation industries, is now being proven by actual service with the armed forces of the United Nations as standard equipment for aircraft, tanks, jeeps, trucks, ships and other combat vehicles. Wittek Hose Clamps are made in many different sizes and types for all applications. Write for new descriptive catalog. Wittek Manufacturing Co., 4305-15 West 24th Place, Chicago 23, Illinois

WITTEK HOSE CLAMPS
Dependable Hose Connections

STRIPPED . . . for Action and Economy

how TUTHILL PUMPS can be built into the design of your machine

To save space, material and money, Tuthill builds stripped pumps for you to incorporate directly into the design of your machine. These internal-gear rotary pumps are furnished without mounting bracket or without housing as pumping elements —for coolant, lubrication, hydraulic and liquid transfer service. Capacities from 1 to 50 g.p.m. Write for Tuthill Stripped Pump Bulletin.

★

Tuthill Pumps are serving Army • Navy Air Force • Merchant Marine and Industry

TUTHILL PUMP COMPANY

939 East 95th Street • Chicago 19, Illinois

Searching for better alloys...

to give you BETTER TUBING

Looking forward to the use of tubing for an ever-wider variety of mechanical uses, the large well-equipped laboratories of Babcock & Wilcox maintain uninterrupted research. Technicians seek constantly to improve present alloys and to discover, if possible, better alloys to meet the expected demand. B&W Tubing is now available in carbon steels, carbon - molybdenum steels, special B&W Croloys, NE. and S.A.E. Alloys, stainless and corrosion-resistant steels.

Babcock & Wilcox are in the unique position of being able to supply *both* Seamless and Welded Tubing for mechanical uses. To the user, this fact has many advantages, not the least of which is the impartial recommendation of experienced engineers who consider only the *right* tubing in its application to the job at hand without prejudice toward any type.

B&W Tubing can be machined or formed into practically any shape; and the present range of steels available offers great opportunities to designers and engineers in planning new mechanical uses.

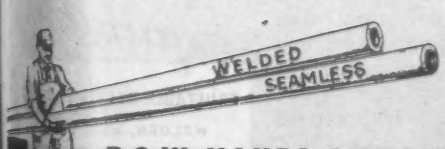
B&W TUBES

SEAMLESS. Complete range of carbon alloy and stainless steels. Sizes: ½ in. to 8⅝ in. O.D.

ELECTRIC-Resistance Welded Carbon grades. Sizes: ¾ in. to 4 in. O.D.

THE BABCOCK & WILCOX TUBE COMPANY

Seamless Tube Division, Beaver Falls, Pa. — Welded Tube Division, Alliance, Ohio



B&W MAKES BOTH

TA-1300A

HYDRO-POWER *Operating Valves* FOR DEPENDABLE HYDRAULIC SERVICE

HYDRO-POWER piston type operating valves are designed with full hydraulic balance in all positions, providing smooth, shockless control of oil-hydraulic circuits. Internal ports and passages are equal to connecting pipe lines, thus assuring free, unrestricted flow.

Designed for heavy duty hydraulic service, up to 2500 pounds per square inch line pressure, **HYDRO-POWER** two-way and four-way piston operating valves will permanently solve your hydraulic control problems. Write today for Bulletin 414.

hydro power

HYDRO-POWER

HYDRAULIC PUMPS AND CONTROLS - VALVES - CYLINDER AND RAM ASSEMBLIES - POWER UNITS - SYSTEMS - SPECIAL HYDRAULIC EQUIPMENT

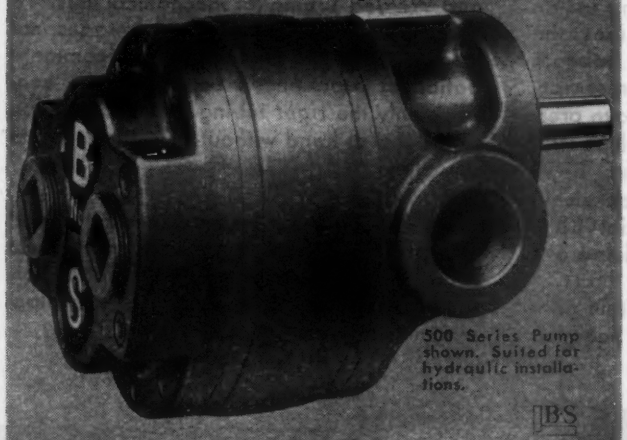
HYDRO-POWER SYSTEMS, INC.

Mount Gilead, Ohio, U. S. A.

Simple — Durable — Efficient

ROTARY GEARED PUMPS

A Wide Range of Styles and Sizes



500 Series Pump shown. Suited for hydraulic installations.

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Brown & Sharpe Rotary Geared Pumps, precision built — with spur, helical or herringbone gears, are suited for lubrication, coolant supply, transfer purposes and hydraulic installations. Catalog on request. Brown & Sharpe Mfg. Co., Providence 1, R. I., U. S. A.

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Let us work out with your engineers the design, application and service of any type anti-friction bearing on which you may need specialized advice. Our research into the operation and performance of bearings—their stress, load and service conditions—qualifies us to be helpful to you in governing your design of Ball and Roller bearings. Thirty-two years engineering experience in the making of high quality, smooth precision, heavy duty, special design and standard bearings over 100 M.M. O.D.

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Dept. PR
WALDEN, NEW YORK

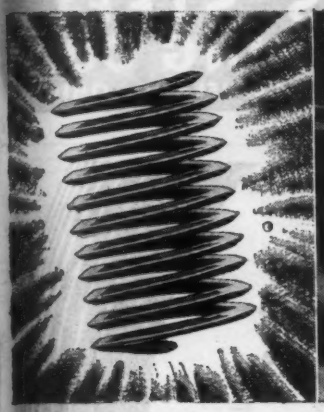
HOW "Heli-Coil" INSERTS REDUCE HOURS TO MINUTES

In the shops of American Export Airlines, Inc., replacement of burned or worn-out spark plug bushings formerly required removal of the cylinder from the engine. This took several hours—often most of a day. Today, "Heli-Coil" inserts restore the bushings to perfect condition in less than an hour—*without removing the cylinder*. They are easily installed—using only simple hand tools in maintenance operations (see photographs below).

"Heli-Coil" inserts are also used in original installations as spark plug and stud bushings, providing a tight wear-resistant, leak-proof fitting. They will not corrode in storage or service, and in the case of spark plugs, eliminate freezing and insulation, permitting removal of spark plug with same torque as used for installation. For assembly on a production basis, power tools are available.

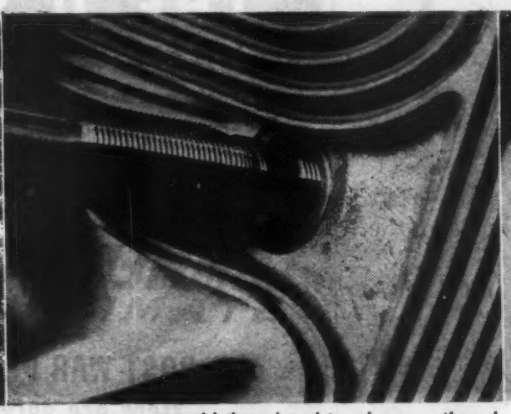
"Heli-Coil" Inserts are precision-shaped stainless steel helical coil thread-liners. They engage the retapped thread of the spark plug bushing, or any American National tapped thread providing a permanent, hard, smooth surface. They are about one-fifth the weight of solid bushings and occupy less than half as much cross sectional area, permitting more latitude in design and greater strength. Send for further information.

THE SCREW SYSTEM WITH THE ANTI-FRICTION THREAD LINING



U. S. and Foreign Patents Issued and Pending

INSERTING tool is placed over the tapped hole and Insert wound through threaded sleeve into hole.



REAMING out old thread and tapping new thread for the "Heli-Coil" Insert, in one operation in shops of American Export Airlines, Inc.

EXPANDING tool ready to be screwed into Insert. Mandrel will then be pushed down into sleeve, forcing Insert into walls of tapped hole.

CLOSE-UP of inserting tool, comprising mandrel and threaded sleeve, with Insert in sleeve.

STAKING sleeve is placed over expanding mandrel until sleeve meets boss. Light blow on top of sleeve knurls chamfered edge around hole, locking Insert into walls of tapped hole.

HELI COIL

AIRCRAFT SCREW PRODUCTS COMPANY, INC.

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"GARLOCK Packings and Gaskets are doing a job on our ships—they'll help us lick our packing problems at the plant back home, too!"

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Gatke BEARINGS developed to do the job BETTER

Quick Facts about GATKE DUPLEX BEARINGS

GATKE Duplex Bearings, illustrated above, are made of resin-bonded fabric materials, precision moulded into mortised bronze castings under heat and tremendous pressure. The result is a complete bearing, combining the marvelous performance qualities of GATKE Moulded Materials and the dimensional stability of bronze.

The castings are made to fit standard bearing holders. Different combinations of moulded materials are used to provide the proper performance characteristics for the particular application.

Duplex Bearings are but one of many GATKE development to overcome difficult conditions and do the job BETTER.

GATKE Bearings are Custom-Bilt to overcome conditions that are too difficult for ordinary bearings. On tough applications throughout most industries they are giving results so superior there is no comparison.

Try GATKE Bearings for your difficult jobs. **Getting acquainted with their many unique advantages has led to marvelous improvement for designers, engineers and users of machinery on countless difficult and unusual applications.**

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Anything up to 3" in diameter in various grains and bonds, including FV, the sensational new bond with a pedigree.

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Shapes and abrasive formulas to take care of every job of internal or external finishing.

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Before approving *any* plans for post war machines, weigh the advantages of the MOTOAIR pump.

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DELIVERS VACUUM or PRESSURE —or Both.

AND ELIMINATES GEARS, GUARDS DRIVES & SHAFTS

MOTOAIR has been reported more accurate; less costly than "electric-eye." Suitable for wall, ceiling, or normal mounting. Motoair lends itself admirably to use as an accessory in many types of machines.

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Protect it from Costly Human Error!

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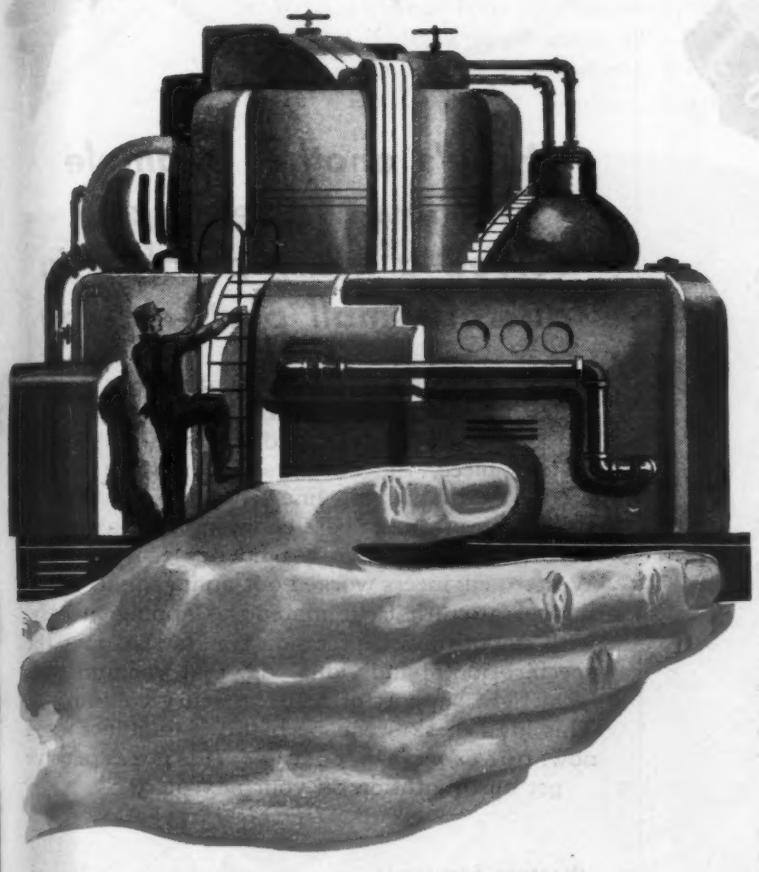
Now that you're sending her out in the world, she's going to be at the mercy of human beings. And just because people are *human*, they make mistakes. Costly mistakes that can cut down the full productiveness of your machine.

But when it comes to lubrication, there is a way to protect your "working girl" and insure her for life against human error. Design-in any one of the four new Alemite Centralized Lubrication Systems—the Alemite Progressive, Alemite Dual Progressive, Alemite Dual Manifold and Alemite LubroMeter.

These Systems were created by Alemite for the single purpose of eliminating "human error" in lubrication. They handle both grease and oil. And they're so adaptable you can build them into almost any type of machine, large or small, singly or in batteries.



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Give Your Machines All These Advantages—Plus Protection!

★ They assure positive lubrication for all bearings.

★ They provide measured delivery of lubricants to each bearing; prevent over-lubrication and under-lubrication. The systems signal when the lubrication job is completed.

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★ They eliminate the need for costly field service. Machines perform better because they are properly lubricated.

★ They add potent sales points to your machines, enhance your own reputation as a designer. Alemite Systems pay for themselves quickly through greater production, lower labor and lubricant expense, longer life of machines.

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One battery of machines had to be shut down 17 minutes each shift for lubrication. An Alemite Centralized System did the job better in 3 minutes—added 5 hours more productive time to each machine each week! That's 260 *extra* working hours per machine every year!

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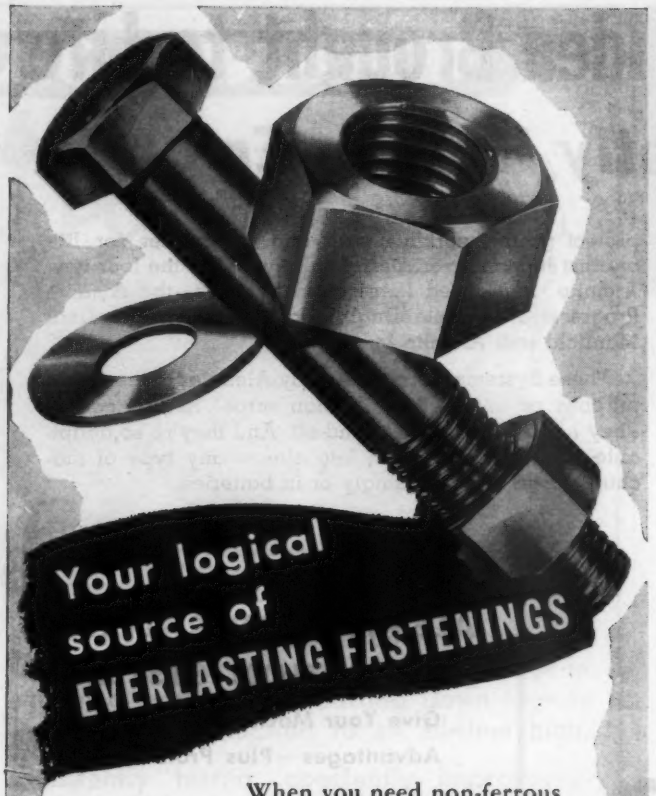
First in Modern Lubrication

CONSULTATION • ENGINEERING • EQUIPMENT • LUBRICANTS • MAINTENANCE



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Harper specializes on non-ferrous and stainless bolts, nuts, screws, washers, rivets and accessories . . . is not concerned with common steel. The Harper engineering and manufacturing staffs are composed of men who have concentrated on the working properties and peculiarities of brass, copper, bronzes, Monel and stainless steel.

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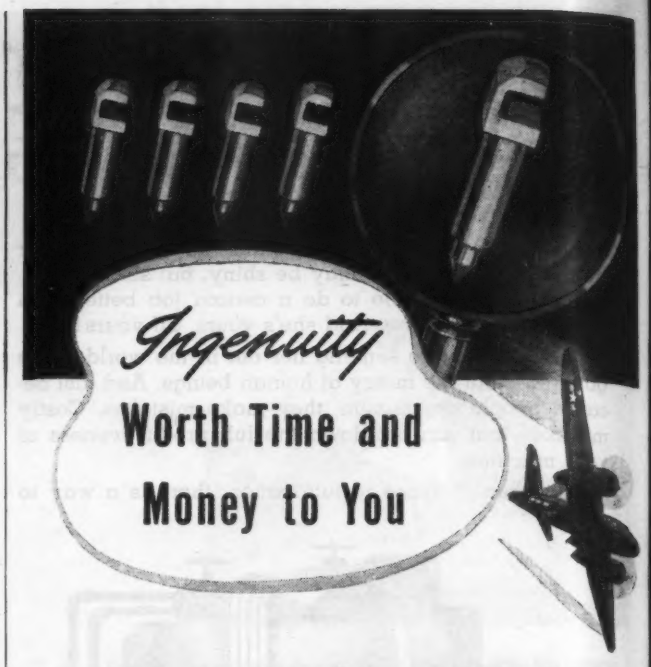

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Here's another example of how Western skill solved a tricky problem in aircraft small parts-making

● It's an airplane carburetor float needle and of course it must work perfectly — nothing less will do. But when it was lapped at assembly with its mating piece, the abrasive action wore a tiny groove at the seating line. Not good in a plane that's miles from its base chopping up Nazi transport — it would have a tendency to stick. But Western engineers worked out an ingenious grinding operation that eliminated the lapping entirely, with smooth finish precision results that met the specification of individual dry-seal vacuum tests — airtight support of a 10″ mercury column . . . This kind of skill can be highly valuable to you now, *but especially postwar*. It is not expensive — get our quotation on your next need.

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We manufacture special precision screw machine products to specifications. Machine capacity ranges from 1/16″ to 4⅝″ round, with complete equipment for all types of secondary and processing operations, including precision grinding, heat-treating, hardening and penetrating.

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Elyria, Ohio, U. S. A.

Precision Parts and Assemblies Since 1873

Destructive heat...brittle cold

TITEFLEX FLEXIBLE TUBING remains flexible and pressure-tight under the widest range of temperature variations. We think, for instance, that you'll be interested in the problem of a phonograph record manufacturer . . .

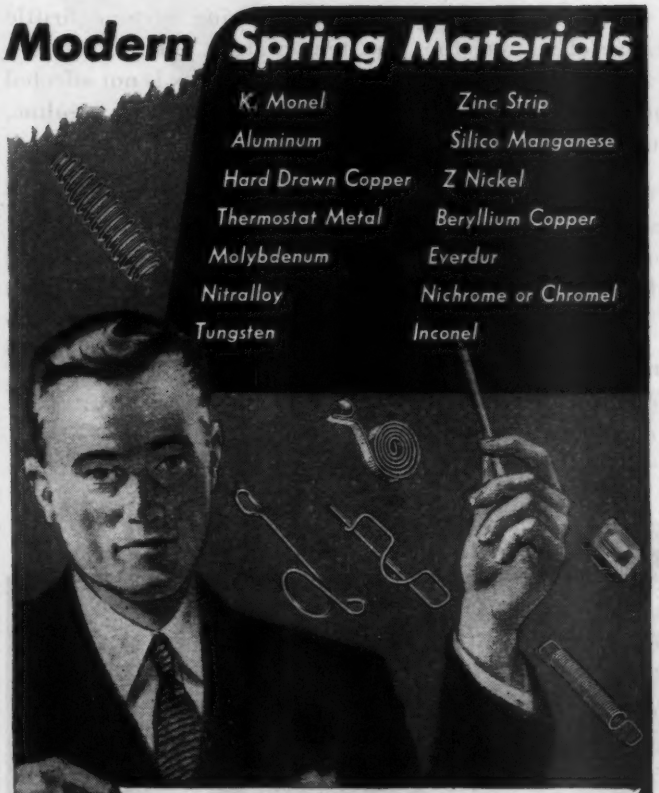
• He makes records on presses like the one in our illustration, and he found the solution to supplying both *steam* and *cold* water to the stationary and movable platens by choosing Titeflex all-metal tubing.

• What a change from the temperatures and pressures of steam applications to -50°F. of high-altitude aircraft installations. Yet Titeflex remains perfectly flexible at -50°F., while other types of tubing become brittle from the low temperature. In addition — because it's *all-metal* — Titeflex is not affected by the destroying influence of oils, gasoline, and most chemicals.

• Undoubtedly the versatility of Titeflex will find many applications in your own plant for your wartime or postwar planning. We'd like you to write for our catalog No. 113 which gives specifications on Titeflex and which suggests many applications of which you might not otherwise think.

TITEFLEX, INC.
518 Frelinghuysen Avenue
Newark 5, N. J.

Investigate the Possibilities of Modern Spring Materials



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THROUGH experience and experiment, Raymond engineers have proved the value of many spring materials for special purposes. This knowledge, applied to your individual requirement, may result in better performance, increased range of service, greater resistance to atmospheric changes and corrosion—all of which means that it pays to design around

RAYMOND SPRINGS

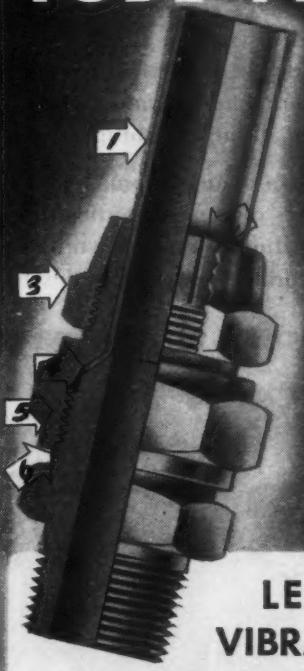
WIRE FORMS — SMALL STAMPINGS

RAYMOND MANUFACTURING CO.
DIVISION OF ASSOCIATED SPRING CORPORATION
CORRY, PENN.

STRONGER
THAN THE TUBING ITSELF

COLLET GRIP
Seals as it grips

TUBE FITTINGS



1 Permit use of tubing in wide range of wall thicknesses.

2 SLOTTED collet insures uniform grip of tubing surface, protecting flare seal.

3 COMPRESSION NUT compresses Collet Nut to tube, forming permanent collet grip that cannot loosen.

4 DESIGN directs pulling stresses and vibration strains away from angle of flare.

5 COLLET NUT has long bearing surface which grips tube securely beyond the flare.

6 Easy to assemble and disassemble. Use repeatedly.

LEAK-PROOF VIBRATION-PROOF

Collet Grip Fittings embody a unique design principle that eliminates transmission of vibration and shock to tube connections—actually resulting in connections stronger than the tubing itself. This means leak-proof connections, and long, trouble-free service. Quickly installed, *Collet Grip Fittings* may be used over and over again—easily assembled or disassembled simply by tightening or loosening the compression nut. No threading, welding or soldering necessary. *Collet Grip Fittings* are now standard equipment in many of the nation's leading industrial plants. Write for Catalog No. 43 containing complete technical data.

LOGANSPORT MACHINE COMPANY, INC.
(Fittings Division)
912 PAYSON ROAD • LOGANSPORT, INDIANA

DOUBLE NUT COLLET GRIPS
—as illustrated above, are made in 5 standard shapes. Special shapes and sizes to specifications.
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SINGLE NUT COLLET GRIPS
Simplified for close work, yet retaining all features of Collet Grip design. Five standard shapes, sizes from ¼" to 1". Special sizes, shapes to specifications.

Designers

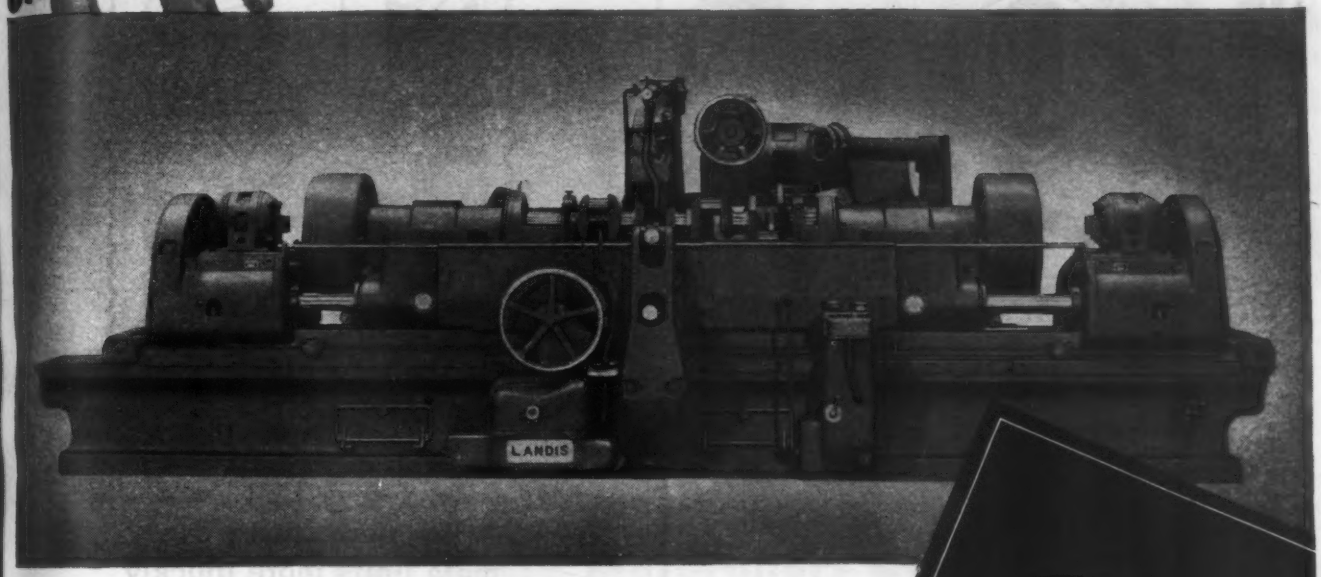
REQUIRING DRIVES FREE OF SHOCK AND VIBRATION

CHOOSE DAYTON V-BELT DRIVES

WHEN AUTOMOTIVE MANUFACTURERS CONVERTED to building aircraft engines, the old tolerances would not do. Now accuracy must be had. So this Crank Pin Grinder was created, which holds to ±.0001, on size.

In working with such precision, the slightest vibration or shock will mar or destroy the ground surface of crank pins in process. The power drive must be utterly smooth and dependable; vibrationless, and free of shock.

The designers and engineers of this machine specified Dayton V-Belts as shown in the drawing. This grinder has speeded aircraft engine production. Its Dayton V-Belt Drives deliver the smooth flowing power as required. Daytons give designers many advantages.



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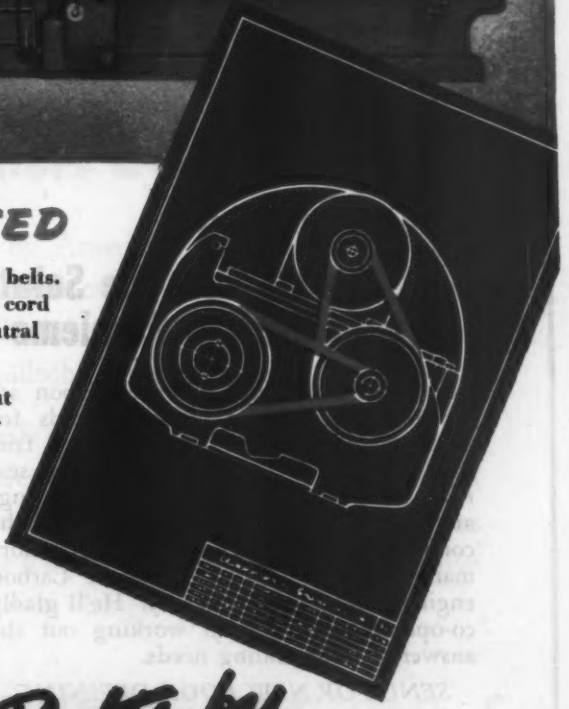
Dayton avoids the "stretch" that handicaps other belts. Dayton V-Belts have special "stretchless" Daytex cord welded firmly under tremendous tension, in the neutral section of every V-Belt by Dayton Rubber.

This prevents Dayton V-Belts "tiring" like belts without such extra, internal strength. That's why designers all over the country have come to depend upon Dayton V-Belts for better gripping and for permanent, smoother operation.



The engineering which distinguishes *Dayton V-Belts* is a typical Dayton Rubber achievement . . . one among many made during 38 years of Technical Excellence in working with both natural and synthetic rubber. When you specify Dayton V-Belts you share in all the benefits of Dayton Rubber's outstanding experience. Get your copy of the Handbook described below.

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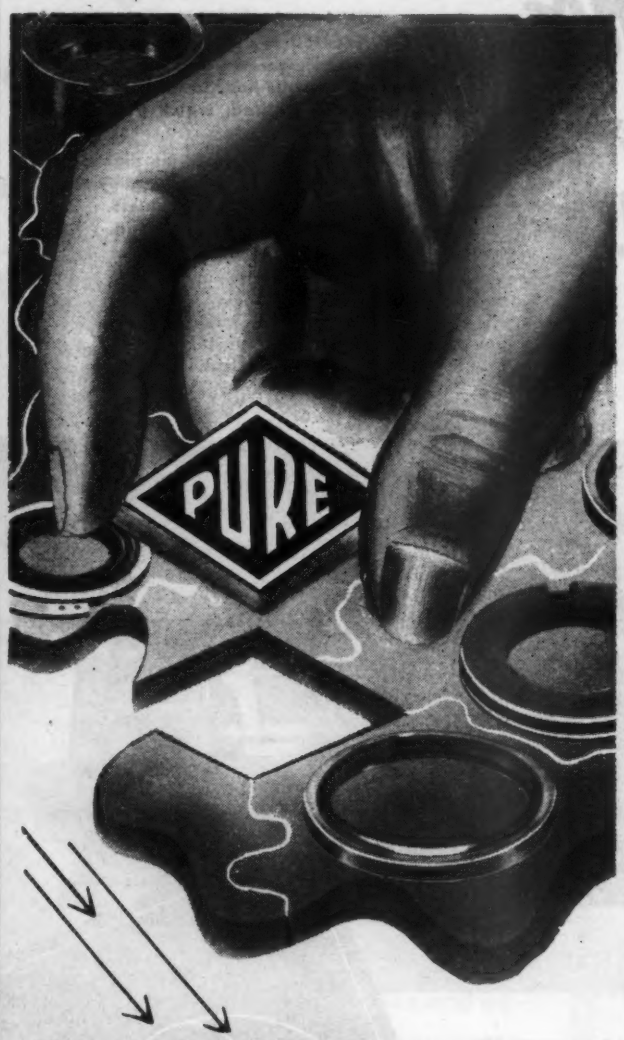
MAINTAIN VICTORY SPEEDS — CONSERVE YOUR TIRES

Dayton Rubber's new 384-page V-Belt Catalog is the most comprehensive encyclopedia of V-Belt information and data ever published. Lists millions of drive combinations — everything you want to know without calculation or engineering. Write for your free copy today.

V-Belts by

Dayton Rubber

The Mark of Technical Excellence in Synthetic Rubber



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Seal rings developed by Pure Carbon are meeting the most exacting demands for efficiency. In applications where low friction, non-abrasive and long-lasting seal rings are a necessity, our carbon seal rings are demonstrating their superiority to the complete satisfaction of increasingly more manufacturers. Consult the Pure Carbon engineer in or near your city. He'll gladly co-operate with you in working out the answer to your sealing needs.

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who says that even the newcomers can mate units more quickly when they assemble

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Sea Level Power 12,000 Feet Up

B-W SUPERCHARGED ENGINES . . .

Pull These Motorailers Over The Andes

Faster acceleration from standstill . . . power to negotiate steep grades . . . sea-level performance at Bogota and points 12,000 feet up—these requirements were readily met by the twenty self-propelled rail cars delivered before the war to the Colombian Nat'l Railways.

Built by American Car & Foundry Company, these cars were driven by Waukesha-Hesselman engines *supercharged* with B-W (McCulloch) Superchargers.

Not only have these supercharged engines met all power demands of the motor rail cars with their trailers, but have also enabled these cars to take the place of unobtainable locomotives in hauling strings of freight cars.

Two of these horizontal type Waukesha-Hesselman six cylinder, electric-ignition engines, suspended under the floor, constitute the power plant of each rail car. Note supercharger in upper corner. It is driven by a V-belt from extension of the crankshaft.

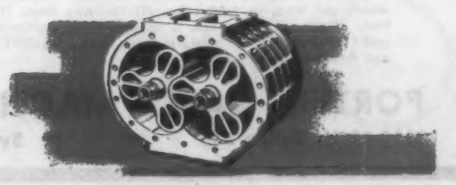
ENGINEERING B-W PRODUCTION

SUPERCHARGERS, INC.

[Formerly McCULLOCH ENGINEERING CORP.]

• DIVISION OF BORG-WARNER

Milwaukee 9, Wisconsin



B-W Positive Displacement Superchargers supercharge at all speeds and in proportion to the need of the engine for air.

NEW! the Porter-Cable BENCH BELT GRINDER

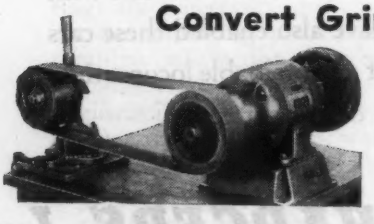
for faster smoother grinding

Replaces Grinding Wheels and Set-Up Wheels

Gives Superior Finish • Line Contract Grinding PLUS
Runs Cooler • Moveable platen for 2-way operation

The BENCH BELT GRINDER is the answer to a hundred needs. Use it as a clean-up machine alongside the miller, shaper, automatics, hacksaw, or shear. It will remove burrs, cutter or tool marks with speed and smoothness. Use it for polishing, grinding irregular shapes, breaking sharp corners, or removing stock. Use it in the gear-cutting department where it will whisk off a burr in an instant. Use it to touch up tools for the set-up men. Use it in the assembly department for fitting parts. Use it in the tool room for reducing stock, grinding flats, making and repairing jigs, or sharpening tools. There are places for the PORTER-CABLE BENCH BELT GRINDER in every department of the plant. Investigate now—delay in installing this "tool of a hundred uses" means lost efficiency on every job.

Convert Grinding Wheels to Smooth, Cool, Clean-Cutting BELT GRINDING

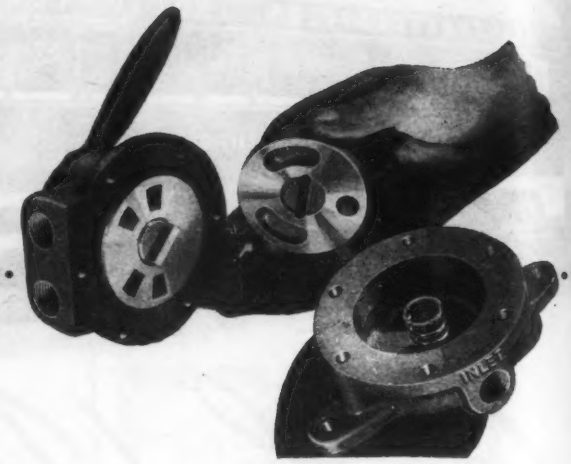


Every production department, repair shop and general machine shop can profitably use abrasive belt grinding by converting old, inefficient methods with the *new* PORTER-CABLE BACK STAND IDLER.

• Write for complete information on these machines which can step up production all the way down the line. We'll send you, too, a book on Belt Surfacing —the method that is revolutionizing many machining and finishing operations.

PORTER-CABLE MACHINE CO.
2110-12 N. Salina St., Syracuse 8, N. Y.

MAKE THE MOST OF AIR POWER



Hannifin "Packless" Air Control Valves provide the smooth acting, positive control of air operated equipment that means better performance and maximum use of air power. Disc-type design, with the bronze disc ground and lapped to make a perfect seal with the seat, does away with packing, provides lasting leak-proof smooth acting control.

Hannifin Air Control Valves are made in 3-way and 4-way types, hand and foot operated, manifold, spring return, and heavy duty rotary types. Write for cylinder and valve bulletin with complete data. Hannifin Manufacturing Company, 621-631 South Kolmar Ave., Chicago 24, Illinois.

Hannifin
AIR CONTROL VALVES

For Bolted Security

LOOK HERE

Nuts do not budge on bolts while there is even the slightest pressure on their threads—but all other parts of bolted assemblies will loosen sooner or later unless a strong spring washer holds all the other parts tight.

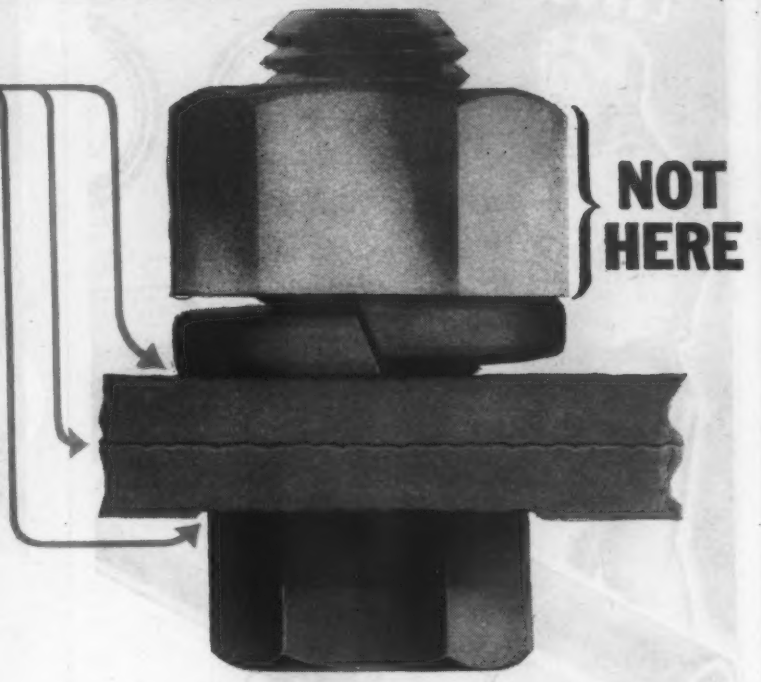
The parts below the nut loosen because of bolt stretch, and frictional wear of metal on metal, burrs and flares; pulverizing paint, rust and scale.

For lasting security you must use a powerful spring washer that expands and compensates for inevitable wear.

There is no substitute on any assembly that is subjected to vibration.

No nut whether it's a regular standard nut or one of the many fixed or lock-nuts can keep the other parts from loosening. So specify National Kantlink spring washers with all or any type of nut, if you want lasting bolted security.

Kantlinks can't lose a test. Write for booklets.



National Kantlinks conform to Government Specifications BECX 1-2-3, AN 935, and drawing 12-Z-22.

Originators of KANTLINK the long-range spring washer

NATIONAL LOCK WASHER COMPANY

NEWARK, N. J., U. S. A.

Let a simple retaining ring save metal and money for you

Every shoulder on your machines or on your metal products should be examined to see whether or not smart engineering could take advantage of these modern artificial shoulders on shafts or in housings.

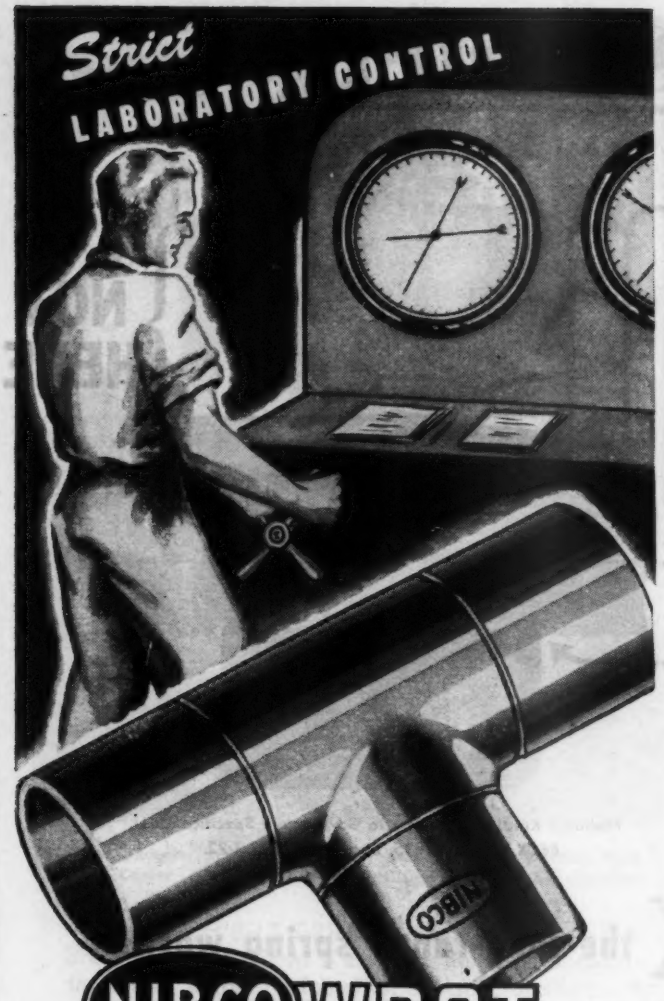
It is needless waste in most instances to turn your shoulders by cutting down larger shafts, when you can groove a smaller shaft and apply a spring steel retaining ring. You'll get better results at great savings.

It's expensive to hold a mechanism in place with unnecessarily big shoulders or collars—or to temporize with small cotter pins, etc. Let us show you how spring steel retaining rings can do a thoroughly efficient job for you.

More and more retaining rings are being used in these days of necessary economy. Every ounce of metal and every cent of cost is more important today than ever before.

Write today for our folder on Retaining Rings.

NATIONAL RETAINING RINGS



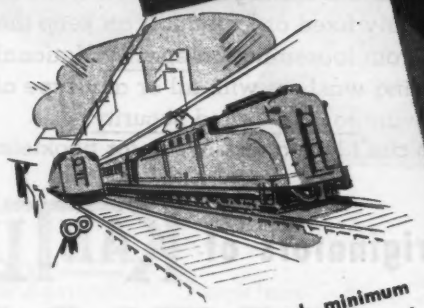
NIBCO WROT Fittings

WHEN designing new equipment for low production cost, remember NIBCO WROT and Cast Fittings and Valves or special tubular parts. Accurate manufacture and perfect sizing make alignment easy and save time. Formed in one step from straight copper, aluminum or stainless steel tubing under tremendous pressures . . . they are the finest solder fittings made . . . vibration-proof and impervious to gases. Not only are tolerances maintained by individual plug tests, but all NIBCO products are manufactured under strict Laboratory Control. Write for catalog and get acquainted with the many items in NIBCO's line that will help solve your design problems.

NORTHERN INDIANA BRASS CO.
ELKHART, INDIANA
VALVES AND FITTINGS SINCE 1904

No. 2 in a Series of Factors Essential to Maximum Brush Efficiency.

. . . Intimate contact with commutator is essential in brush operation



Quiet brush operation and minimum commutator wear is dependent on several factors.

The commutator must be true, and the mica properly undercut. Spring pressure must be sufficient to provide intimate contact at all times, but not too great to cause excessive wear of brushes and commutator.

A complete range of Morganite grades with good inherent riding qualities and low coefficient of friction assures low commutator maintenance.

Morganite engineers will be glad to recommend the correct brush and the correct pressure for your particular problem. Write to Morganite Brush Company, Inc., Long Island City, New York.

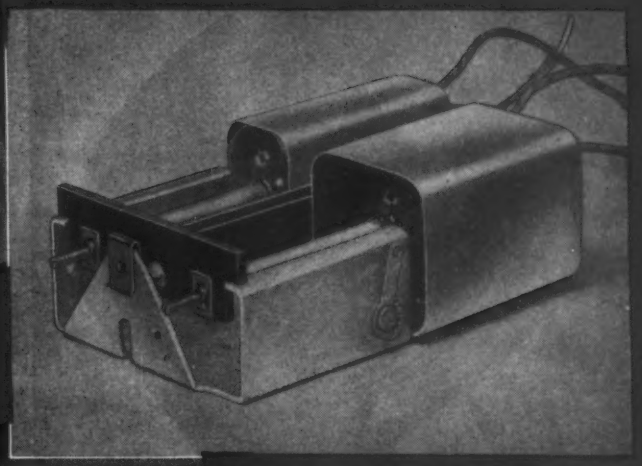
TRADE MARK

MORGANITE BRUSHES

THE Self-Retaining "U" Type SPEED NUT

SPEEDS UP AND IMPROVES ASSEMBLY OF STOVES, RADIOS AND MOTOR VEHICLES

Self-retaining "U" nuts speed assembly of stove panels and door liners. They fasten parts securely, yet are resilient enough to prevent undue damage.



Heavy duty "U" nuts fasten muffler bracket to frame. One operator makes complete attachment with power screwdriver, as "U" nuts are self-retained in position.

"U" type SPEED NUTS are easily and quickly applied — just snapped by hand into screw-receiving position — no welding, riveting or clinching necessary. No wonder "U" nuts SPEED UP product assembly!

"U" type SPEED NUTS hold tight — their arched prongs absorbing vibration to prevent loosening. Yet, their resiliency prevents damage to the parts they hold. No wonder "U" nuts IMPROVE the finished product! Available in many shapes and sizes, "U" type SPEED NUTS fit a wide range of thicknesses—metal plastic or glass.

Send us your design details and we'll show you how SPEED NUTS can cut assembly time and cost and improve the quality of your product too. Write today!

TINNERMAN PRODUCTS INC.

2041 FULTON ROAD, CLEVELAND 13, OHIO

In Canada: **Wallace Barnes Co., Hamilton, Ontario.** *In England:* **Simmonds Aerocessories Ltd., London.**

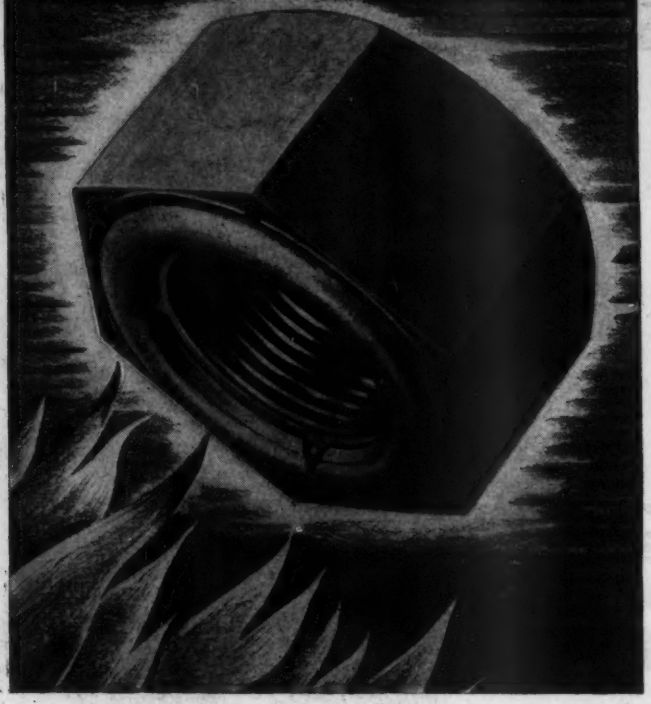
Speed Nuts* PATENTED

*Trademark Reg. U. S. Patent Office

FASTEST THING IN FASTENINGS

no quitting in the

hot spots



Heat does not affect the all-metal An-cor-lox lock nut up to the softening point of the metal. What's your specific application? The correct metals or alloys can be chosen . . . so that locking efficiency will be unimpaired, even on an extreme high-temperature job. ● Similarly, corrosion-resistant metals may be selected for this one-unit lock nut construction. ● Write for the An-cor-lox story on new locking security—also for An-cor-lox sample.

An-cor-lox
TRADE-MARK REG
Lock Nuts

An-cor-lox Division
LAMINATED SHIM COMPANY
Incorporated
63 Union Street • Glenbrook, Conn.
2066

ACCURACY

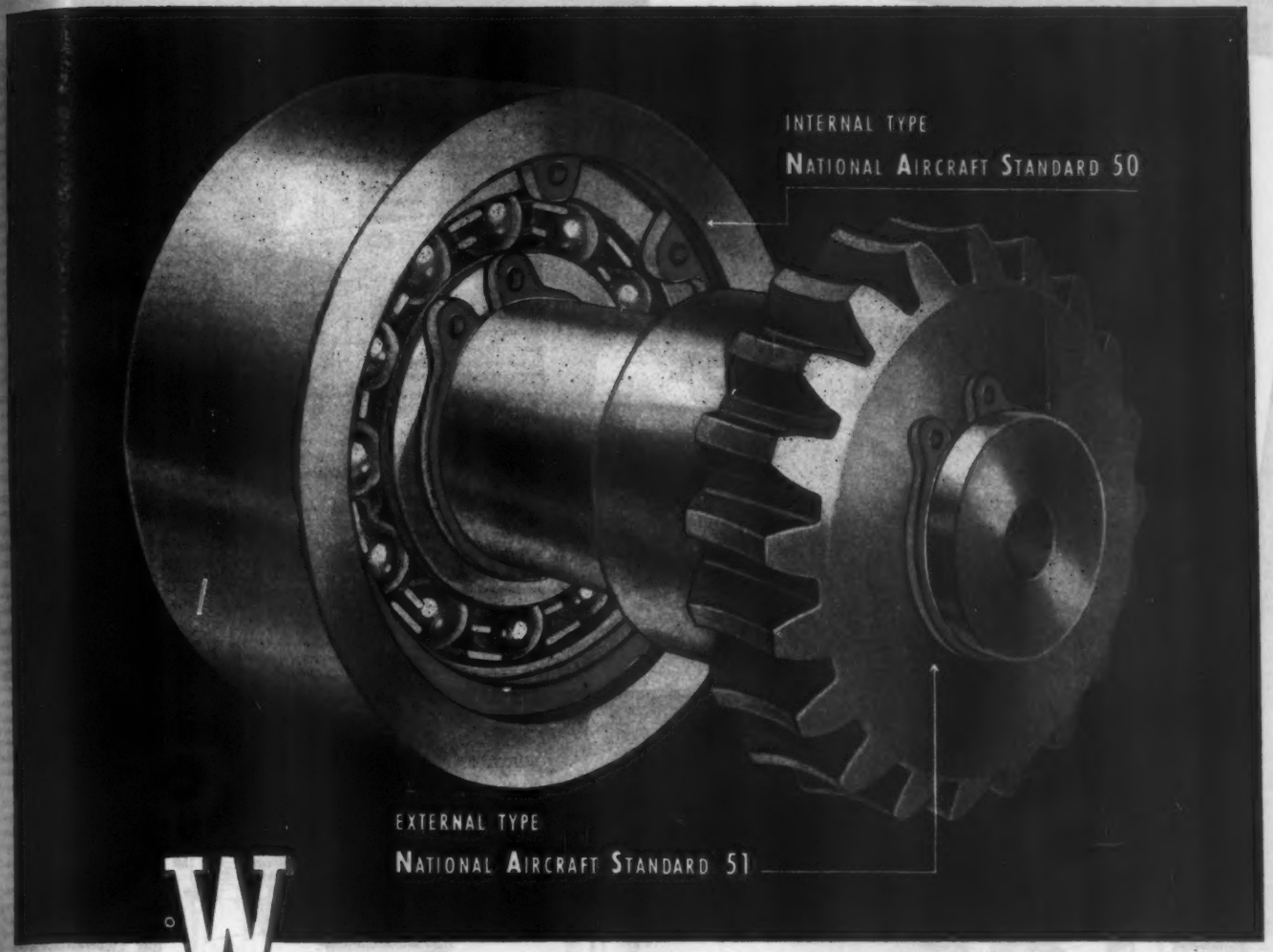
The surgeon's deft hand is clumsy in comparison with the exacting requirements of Milford's shop standards.

The building of precision fasteners for Uncle Sam's war needs, exactly to specification — accurately, smoothly finished and delivered on time—has resulted in a vastly increased capacity for accurate service in the peace-time production of rivets, Phillips recessed-head screws, and other fastening devices in which MILFORD specializes.

Accurate FASTENING SERVICE is also your privilege whether or not MILFORD be your source of supply for fastening devices. We are always interested in working with "hard to satisfy" people.

The
MILFORD
RIVET & MACHINE CO.

EASTERN DIVISION — CENTRAL DIVISION
MILFORD, CONN. ★ ELYRIA, OHIO



Waldes Truarc presents a significant advance in retaining rings.

It spreads or contracts without distortion; always retaining its perfectly fitting circular contour.

For thrust-load fixing, and shaft and housing applications, Waldes Truarc provides distinct advantages over nuts and bolts or wedges and washers . . . it reduces dimension and weight . . . saves material . . . cuts manufacturing time . . . simplifies assembly and dis-assembly. On request, we will gladly furnish samples and full data for your tests.

WALDES

U. S. Patent
Re 18144

TRUARC

RETAINING RING

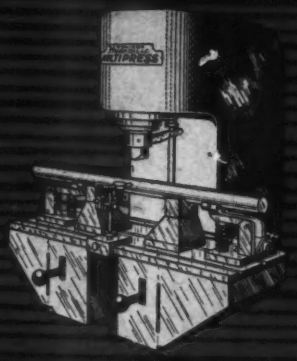
WALDES KOH-I-NOOR INC. — **LONG ISLAND CITY, N.Y.**

Sole Manufacturers in U. S. A.

CANADIAN REPRESENTATIVES: PRENCO PROGRESSIVE & ENGINEERING CORP., LTD. 72-74 STAFFORD ST., TORONTO

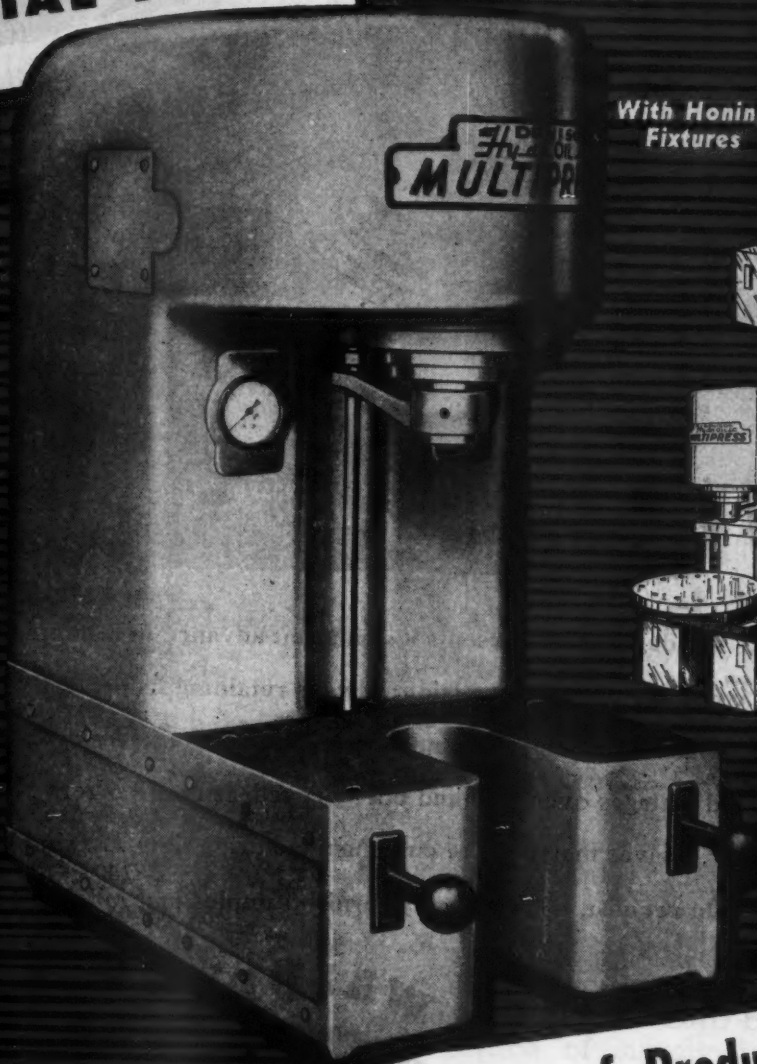
Announcing MULTIPRESS

AN ENTIRELY NEW KIND OF INDUSTRIAL TOOL

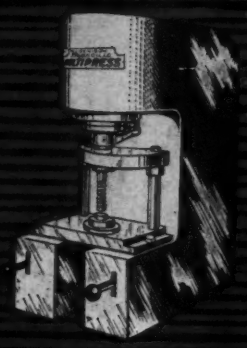


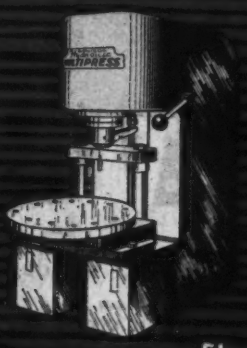
With Straightening Fixtures

With Honing Fixtures

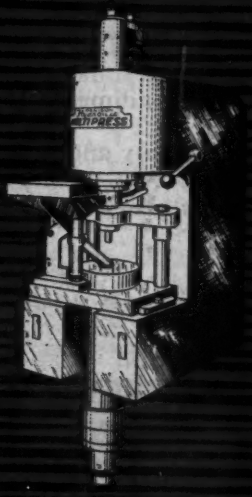


With Broaching Attachment

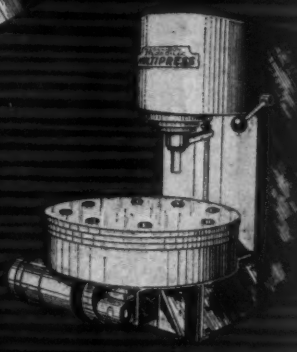




Showing Dial-Type Feed



Equipped for Automatic Pelleting



With Motor Driven Indexing Table

For Scores of Production Jobs

A 4-ton production giant in midget form . . . a completely self-contained, bench-size, oil-hydraulic machine tool of amazing scope. MULTIPRESS delivers downward ram pressures of from 300 to 8,000 pounds . . . upward pressures to 5,000 pounds . . . in strokes which may be regulated from 6 inches to 1/16-inch . . . at ram speeds up to 200 inches per minute downward, and 300 upward! Its work-table measures 10½ x 16 inches without extensions. The opening between ram and table is 11 inches. In addition, there are fixtures and attachments for MULTIPRESS which fit it for almost every type of operation requiring pressure . . . sustained, in repeat strokes, synchronized with indexing tables, in single or automatically repeated cycles, and many other ways! Write today for details on this new HydrOILic tool of multiple uses!

Basic Unit $575.00 f.o.b. Co

The Denison Engineering Company

1157 Dublin Road, Columbus 16, Ohio

DENISON EQUIPMENT for APPLIED HydrOILics

HydrOILics EASIEST INDUSTRIAL WAY

FROM 5 to 200 G.P.M.
with the same pump

A ROTOR A PISTON A SHUTTLE

One model of Yale & Towne's Tri-Rotor delivers certain fluids at any rate from 5 to 200 G. P. M. when equipped with the Variable Volume Control. The extreme flexibility of this pump has many uses in modern industry.

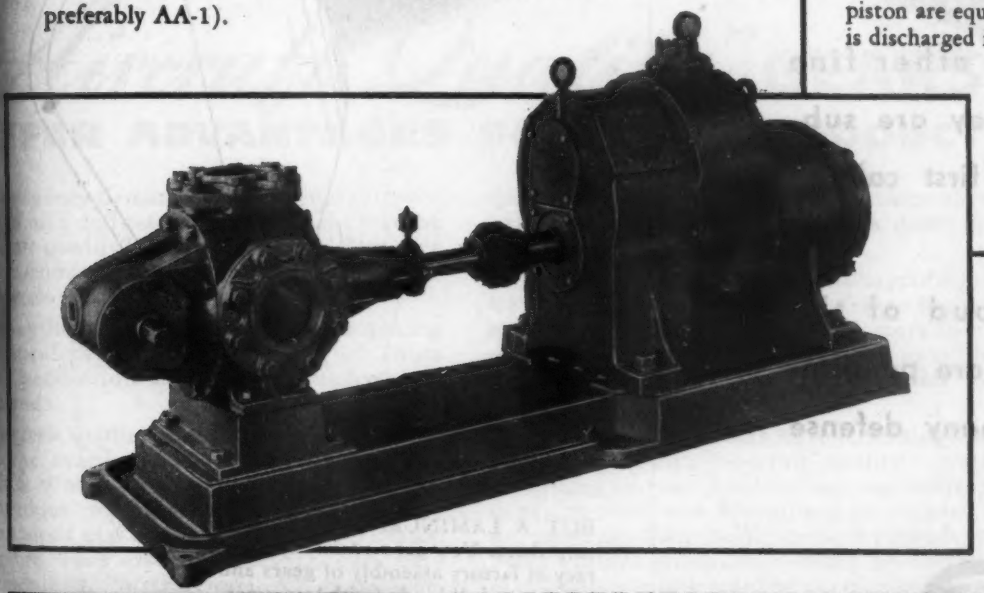
Yale & Towne Tri-Rotors are the only *low pressure* pumps that give you the *positive handling* of a piston pump (for *product protection*) plus the *power efficiency* of a rotary pump (*for lower operating costs*). These two factors guarantee finest handling characteristics — no foaming, chewing, aerating or overheating of the product. At the same time they assure highest volumetric efficiency in the pumping of either thin or viscous fluids.

Prompt delivery is now available on Tri-Rotor Pumps for purchase orders carrying AA-5, or better. (Orders requiring the purchase of electrical equipment should be supported by an AA-2x or better, preferably AA-1).

Only 3 Moving Parts

When the rotor revolves, the reciprocating motion of piston and shuttle, acting by and in rotation, positively displaces the liquid. Since rotor openings receive and discharge every 90 degrees, four pumping strokes overlap; and since areas of shuttle and piston are equal, a smooth flow of liquid is discharged into the outlet line.

Exclusive features: Variable Volume Control (optional), Manual Flow Control (optional), Integral Relief Valve Head. 5 G.P.M. to 200 G.P.M.



WIRE OR AIR MAIL YOUR REQUIREMENTS TO PUMP DIVISION

Makers of the famous Yale Line of Locks, Door Closers, Hardware, Hoists and Industrial Trucks.

TRADE YALE MARK

PUMP DIVISION OF

THE YALE & TOWNE MFG. CO.

Stamford, Conn., U. S. A.

THE YALE & TOWNE MFG. CO., 211 Henry Street, Stamford, Conn., U. S. A.

AVAILABLE NOW on orders carrying properly executed priority certifications. (There may be a short delay when electric motors are required)

The Yale & Towne TRI-ROTOR Pump is now in use pumping such products as these (check application which interests you)

☐ Gasoline	☐ Solvents	☐ Molasses	☐ Jam
☐ Lacquer	☐ Viscose	☐ Corn Syrup	☐ Coolants
☐ Paint	☐ Silicate of Soda	☐ Starch	☐ Fish Oil
☐ Varnish	☐ Glucose	☐ Ink	☐ Grease
☐ Caustics	☐ Liquid Soap	☐ Alcohol	☐ Shortening
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Like many other fine products, they are subject also to first call by Uncle Sam.

We are proud of the service they are performing in so many defense jobs.

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RHEOSTATS and RESISTORS
DIVISION OF
THE NATIONAL LOCK WASHER CO.
ESTABLISHED 1886
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Perhaps just the TIME SAVING interests you

BUT A LAMINUM SHIM doesn't stop there. You get *certainty* of accuracy in factory assembly of gears and bearings of all kinds (with less supervision) plus the ease with which adjustments in service may be made with the same Laminum shim. Advantages too great to be minimized. Bulletin and application photo chart on request.

Laminum shims are cut to your specifications. For maintenance work, however, shim materials are sold through industrial distributors.

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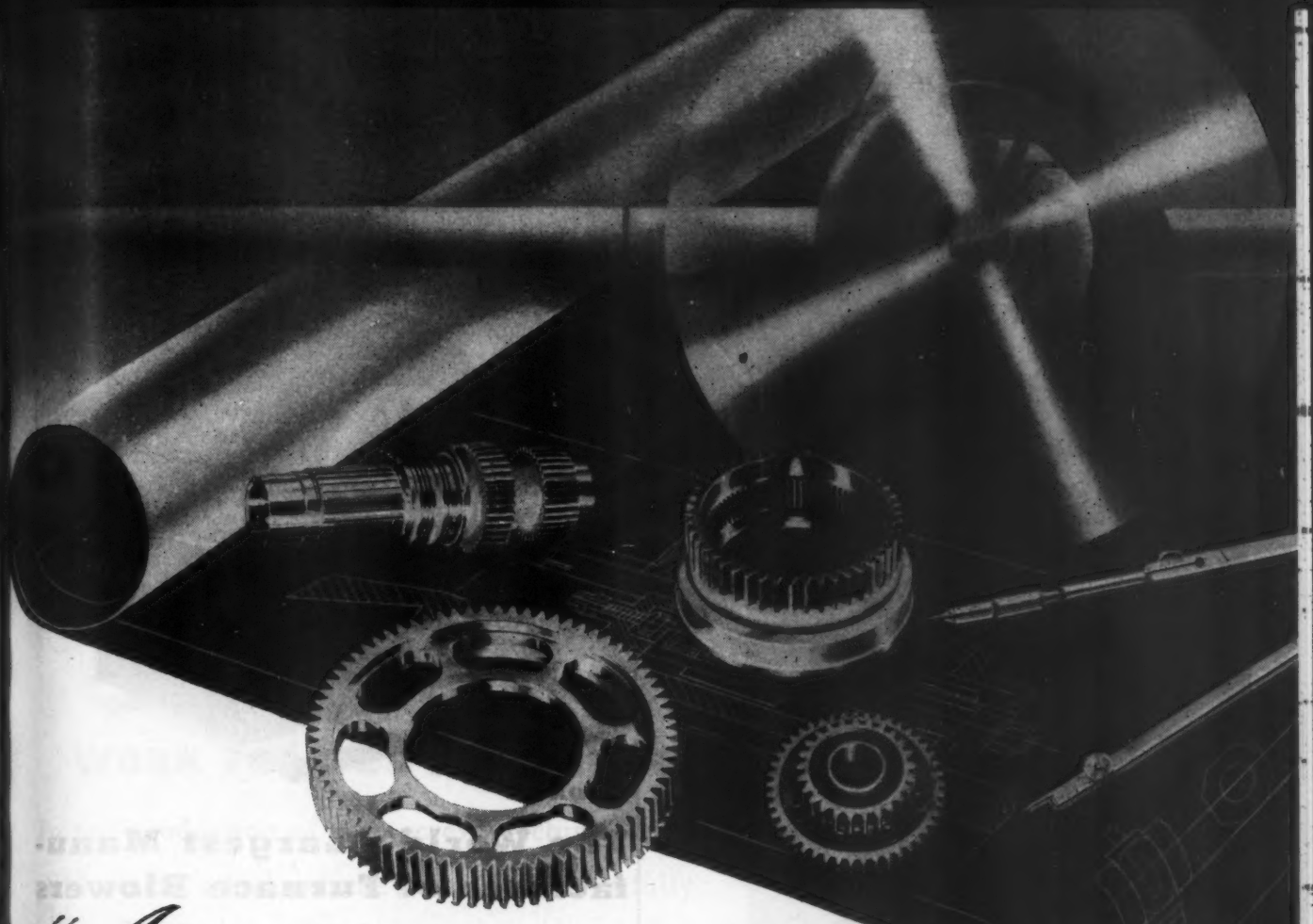
THE SOLID SHIM THAT peels FOR ADJUSTMENT



"Aircraft Quality" GEARS

OFFER ADVANTAGES FOR YOUR PRODUCT

War urgency demands the seemingly impossible of men and machines. Before the war the "aircraft quality" gears that Foote Bros. are today producing were hardly more than an engineer's ideal.

Today these gears, closely approaching theoretical perfection, are flowing off Foote Bros.' production line by the hundreds of thousands.

"Aircraft quality" gears were developed to meet the exacting demands of the powerful Pratt & Whitney engines. Light weight and tremendous strength—the ability to stand high speeds and heavy loads, and yet assure long life were essential. Despite extremely thin sections, "aircraft quality" gears must carry tooth loads far in excess of values customarily considered safe design and must operate at pitch line velocities that can be measured in miles per minute.

These unique qualities of Foote Bros. "aircraft quality" gears offer many advantages to manufacturers of equipment requiring the transmission of power. Right now in the drafting room and experimental laboratories of many of these manufacturers—designs for tomorrow's peacetime machines are being developed—new machines whose performance will be improved by the Foote Bros. gears incorporated in their design.

"Aircraft quality" gears may solve problems for your engineers—they will assure higher speed, longer life, lighter weight, more compact design—they may even make possible new developments that otherwise would be impractical.

To aid your engineers in determining the advantages which "aircraft quality" gears will bring to your product, our engineering department is now developing an engineering manual which should be in the hands of every designing engineer—every production man—facing problems of power transmission. A copy will be sent on request as soon as it is ready.

FOOTE BROS. GEAR AND MACHINE CORPORATION
Dept. W, 5225 S. Western Blvd. • Chicago 9, Illinois

This informative product engineering manual on "aircraft quality" gears contains data on a new and revolutionary type of precision gear. A copy will be sent to you on request as soon as it is ready.

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Better Power Transmission Through Better Gears

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Please send me a copy of the Engineering Bulletin on "Aircraft Quality" Gears as soon as it is available.

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LINEAR "PAR" PACKINGS

Seal In HYDRAULIC POWER

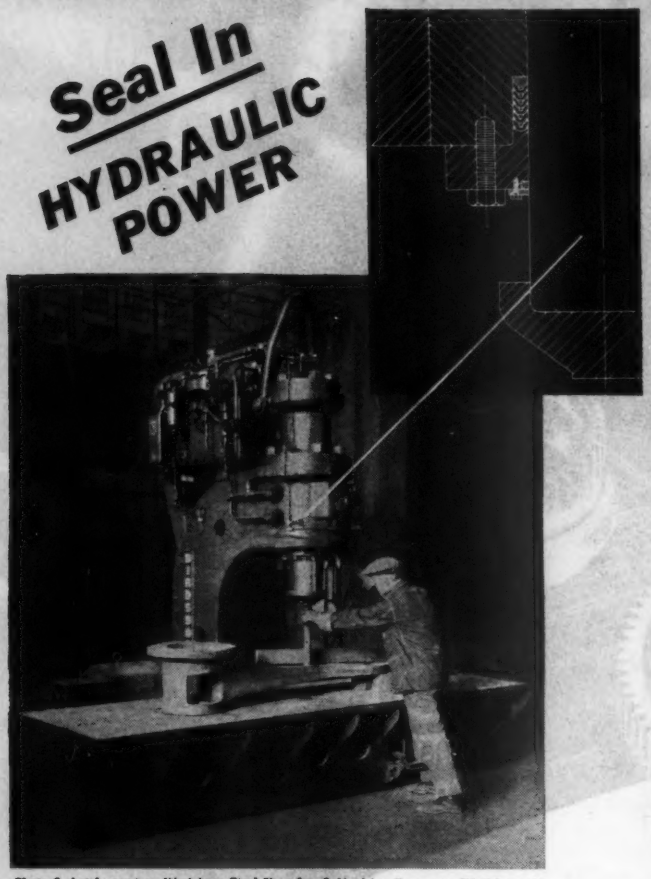


Photo & sketch courtesy Birdsboro Steel Foundry & Machine Company, Birdsboro, Pa.

Oil is the hydraulic fluid which powers this Birdsboro Straightening press . . . C-Housing type. And again, Linear was called upon to furnish the packing rings which efficiently fit into the precision design of the actuating mechanism. The main ram delivers 50 tons pressing force under 3000 pounds per square inch pressure.

Linear "Par" packings effectively seal in the vital hydraulic power from source to point of application. All the power produced by the press is delivered at the ram aided by Linear's fluid-tight, thoroughly dependable seal . . . the seal which is the direct result of Linear "Par" packing's precision design, exacting production and meticulous inspection.

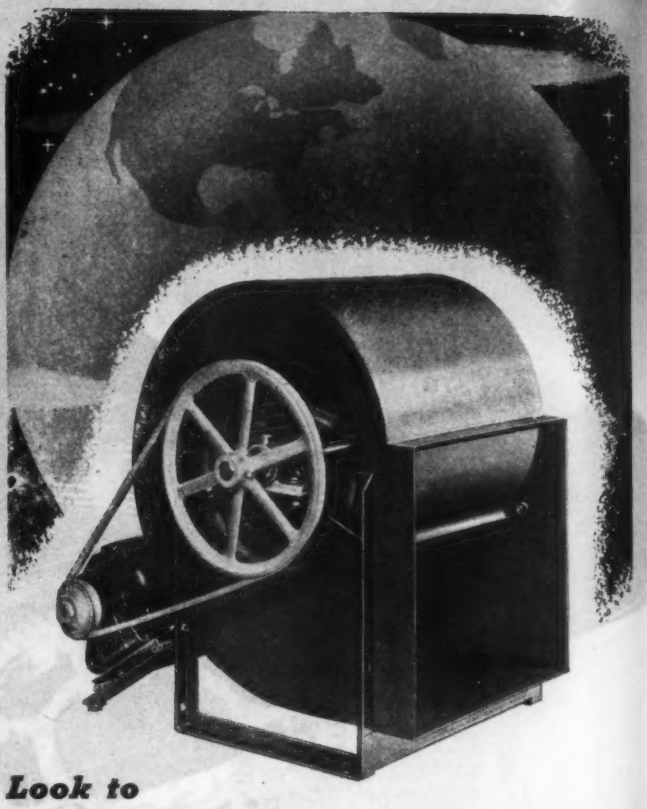
Unaffected by oil, impervious to *any* fluid employed as a pressure medium, Linear "Par" packings are manufactured from six compositions each for a specific service. Engineers of the most modern hydraulic equipment have selected "Par" packing — confident of its ability to aid hydraulically actuated mechanisms in delivering peak performance.

The consultation of Linear engineers is available . . . ask Linear to cooperate with your designers in stepping up the efficiency of *your* hydraulic products. Sample packings for your experimentation upon request.

LINEAR

PACKING & RUBBER CO.

STATE ROAD & LEVICK STREET
TACONY, PHILADELPHIA 35, PENNA.



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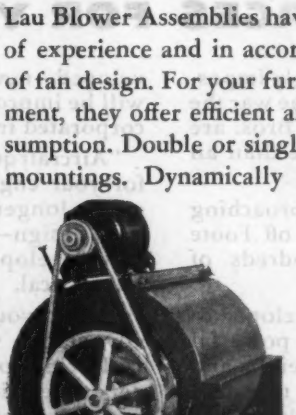
The World's Largest Manufacturer of Furnace Blowers

as your best source for

BLOWER ASSEMBLIES

Lau Blower Assemblies have been developed through years of experience and in accordance with approved principles of fan design. For your furnace and air conditioning equipment, they offer efficient air delivery with low power consumption. Double or single inlet. Top, side, or rear motor mountings. Dynamically balanced wheels. Self-aligning bearings. Widest range available. Greatest selectivity of air delivery. Every size tested and rated for performance in accordance with A.S.H. & V. E. and N.A.F.M. Codes. Get your orders in NOW. Write for complete description, simplified selector chart for sizes, capacities, etc., and prices. Lau engineers will serve you gladly.



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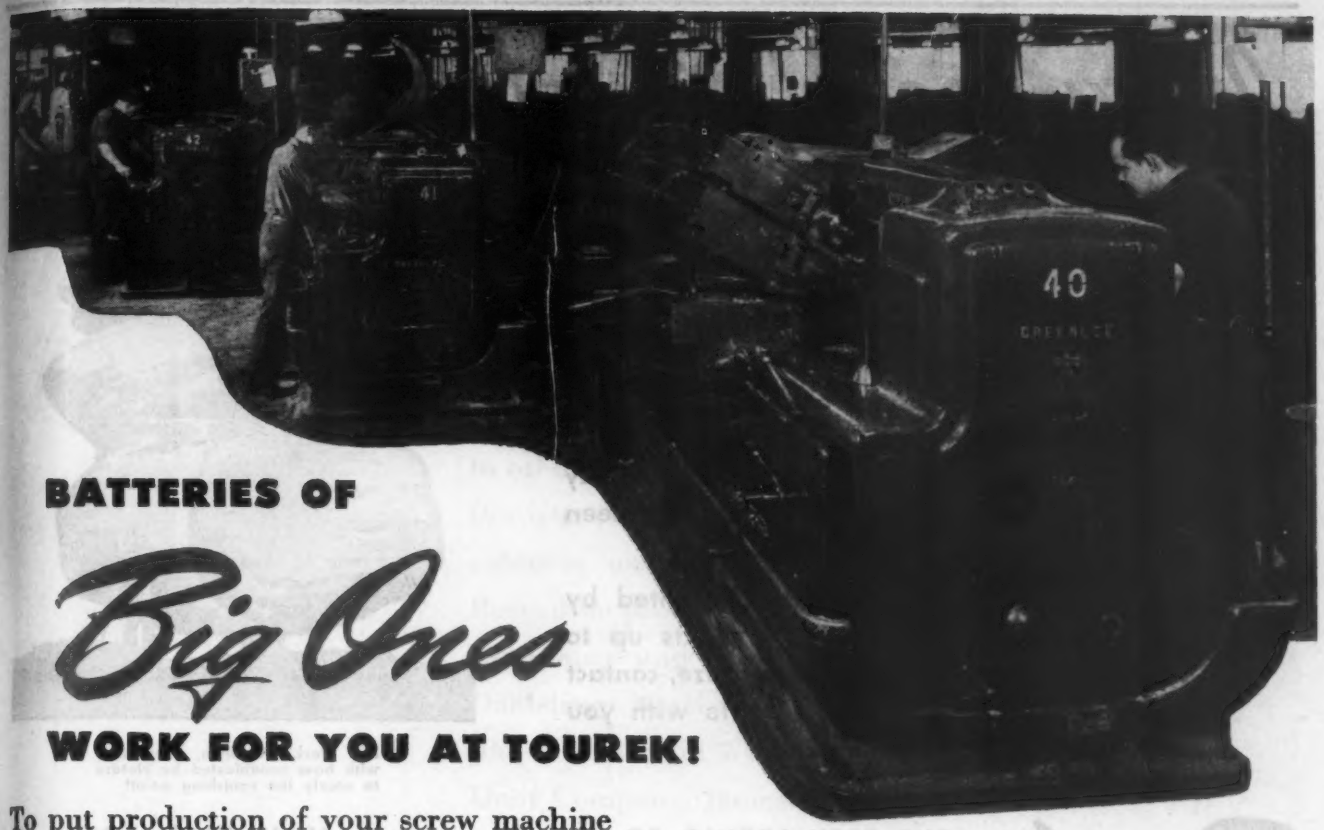
DAYTON 7, OHIO

WORLD'S LARGEST MANUFACTURERS OF FURNACE BLOWERS

Engineers and fabricators of general Air Handling Equipment
Single Inlet and Double Inlet Blowers • Propeller Fans • Accessories



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Big Ones

WORK FOR YOU AT TOUREK!

To put production of your screw machine products on a real volume basis, Tourek is fully equipped with the "big ones"—four- and six-spindle automatics of latest design. These and smaller automatics, together with all necessary machines for secondary operations, backed up by outstanding tool room and engineering facilities, enable Tourek to produce your parts in any quantity . . . in any type of metal . . . and in any size up to 2⅝ inches. Put Tourek's engineering ingenuity, top notch equipment, and successful experience of nearly a quarter century to work for you!

J. J. TOUREK MFG. CO.
4701 W. 16TH STREET CHICAGO 50, ILLINOIS

MAKERS OF THE FAMOUS
TOUREK BALL JOINTS

ESTABLISHED 1920

TOUREK

PRECISION SCREW MACHINE PRODUCTS

Why doesn't it fall?

The fulcrum of this remarkable rock formation is 100% right in design. The instant it ceases to be so, Idol Rock will crash!

Often in product design, a very small part is entrusted with great responsibility—sometimes with the successful operation of the product itself. When required, "Peck Service" supplies such important parts in long runs of precision accuracy . . . is doing it now for Uncle Sam . . . had been doing so during many peace-time years.

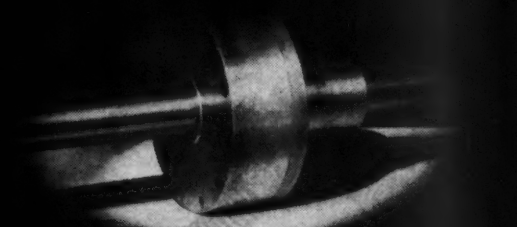
If your postwar plans would be benefited by carefully made screw machine products up to 1¼" size or by springs up to ⅛" wire size, contact us now. We'll be glad to collaborate with you in advance of the actual need.

Idol Rock, Brimham, Yorkshire, with base sandblasted by Nature to nearly the vanishing point!

Peck THE PECK SPRING CO., 14 Summitt St., PLAINVILLE, CONN.

SPRINGS & SCREW MACHINE PRODUCTS

★ ★ ★ THE HILLIARD ★ ★ ★



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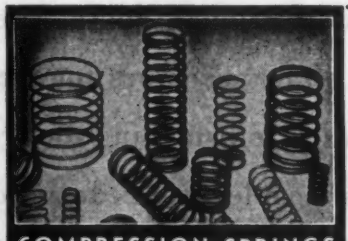
A "Free Wheeling" Clutch of simple design recognized for many years as "Standard Equipment" for Automatic Dual Drive Operation—Automatic operation of 2 speed drive—As a ratchet permitting infinite adjustment and as an automatic backstop. Furnished in a number of types.

★ *WRITE TO-DAY!* Giving full particulars of your requirements, Hilliard Engineers will tell you how to adapt this clutch to your needs.

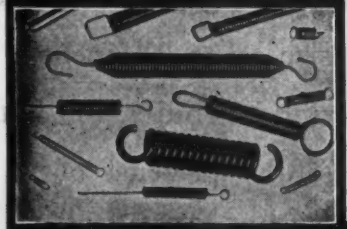
THE HILLIARD CORPORATION

101 West Fourth St. Elmira, New York

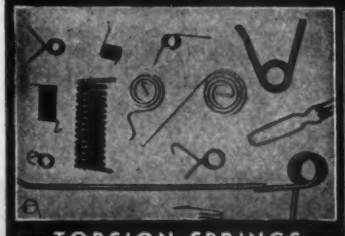
★ CENTRIFUGAL SINGLE REVOLUTION FRICTION ★



COMPRESSION SPRINGS



EXTENSION SPRINGS



TORSION SPRINGS

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It's Made From ROUND OR FLAT WIRE

Cuyahoga Spring Co. can make it, including welded, pointed or threaded parts in any metal or finish. Send for descriptive folder.

SNAP CLIPS

THE CUYAHOGA SPRING COMPANY

10270 BEREA ROAD

CLEVELAND, OHIO

PUT DAHLSTROM TO WORK ON YOUR *Postwar products*

While we too, are loaded with war work, our design and engineering departments have time to devote to other problems. If your postwar product involves the use of metal fabricated shapes, stampings or cabinets, our engineers can help you get set for Peacetime production. An outline of our 40 years' experience and skill is graphically shown in two Dahlstrom Metal Specialties folders which we would like to send you. Write us now. Dahlstrom Metallic Door Company, Jamestown, N. Y.

Dahlstrom redesigned this Radio Transmitter Box from stainless steel to ordinary sheet steel, saving the critical stainless. Horizontal embossments and vertical corner members supply fully requisite strength while permitting use of lighter gauge metal. Sketch shows amount of original welding. The redesigned box has only one welded joint in each corner ... a considerable saving, as the box must be water-tight. Rejections were very high in previous construction. Original top hook fasteners were stainless forgings. Manganese bronze forgings reduced cost while still providing adequate strength. Cover is stamped from one piece of sheet steel. Total cost saving was over 50%.

Material: .020 Ga. Steel, Bonderized. Size: O. A. Box—15-29/32"x7-29/32"x9-5/16" high.
Finish: Outside—Black Wrinkle.

ARMY E NAVY

DAHLSTROM METAL SPECIALTIES

Designing, Engineering and Fabricating of Special Cabinets . . Racks Mouldings . . Control Desks and Panels . . Radio Chassis . . Stampings Enclosures . . Pressed Shapes . . Product Cases . . Special Parts

Stewart-Warner reports on ELGIN Sapphire RING Gages!

Sapphire outwears steel 100 to 1!

STEEL RING GAGES, formerly used to check shafts in a Stewart-Warner plant, were good for only 250 gagings each. An Elgin *Sapphire* Ring Gage on the same job showed absolutely no wear after 25,000 (100 times as many) gagings! 300 to 1 was their latest report on Elgin Sapphire *Plug* Gages used over a longer period.

Because sapphire is the next hardest material to diamond, there's no wear allowance necessary with Elgin Sapphire Ring Gages. They can not rust, burr, corrode or become distorted with use.

Elgin Sapphire Ring Gages are mounted in plastic or brass and come richly cased. Sizes from .004" to .250" and in tolerances from .00020" down to .00004". Write for prices and more detailed information.

ELGIN SAPPHIRE PRODUCTS PRESENT MANY ADVANTAGES FOR THE FOLLOWING TYPES OF EQUIPMENT:

Ring Gages • Bearings • Thread Guides • Extrusion Dies • Diesel Injector Nozzles • Knife Edges • Spray Nozzles • Gages • Soft Wire Dies • Phonograph Needles • Cutting Tools for soft metals • Burnishing Tools for soft metals • Pressure Vessel Windows • Electrical Insulators • Watch Crystals • Honing Stones.

America's best equipped sapphire fabricator

ELGIN NATIONAL WATCH COMPANY

Sapphire Products Division

★ 932 Benton Street, Aurora, Illinois, U. S. A. ★

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Dresser prompt service frequently saves customers "down time". Delivery promises are reliable, and over fifty years' production experience enables us to do precision forging work.

Include machining with your inquiry.

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DRESSER MANUFACTURING CO.
BRADFORD, PA.

CHROME ALLOY • CARBON STEEL • STAINLESS STEEL • BRONZE • K-MONEL • ALUMINUM • GLASS • PLASTICS • DRILLED BALLS

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Hartford PRECISION BALLS

Precision balls to meet your specific requirements...wear resistant . . . corrosive resistant . . . heat resistant . . . consult our Engineering Department for recommendations.

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NEW YORK OFFICE MURRAY HILL 6-1923 | EXPORT OFFICE: NEW YORK PHONE: PENNSYLVANIA 6-2078 | CHICAGO OFFICE HAYMARKET 8671

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TO MANY TOUGH ENGINEERING PROBLEMS

Is your problem one of conveying liquids, steam or gases . . . isolating vibration . . . compensating for misalignment . . . connecting moving parts? It is likely that an American Flexible Metal Hose or Seamless Tubing design will provide the solution.

"American" has an enviable reputation for dependability. It withstands high temperatures and pressures. In applications where abrasion or chemical action would render non-metallic hose impractical to use, American Flexible Metal Hose or Seamless Tubing offers rugged service life and maximum economy.

Send for a copy of Bulletin No. SS-50. This valuable booklet contains information for every manufacturer, engineer and machine designer. 44204

A few of the many types of "American" Products.

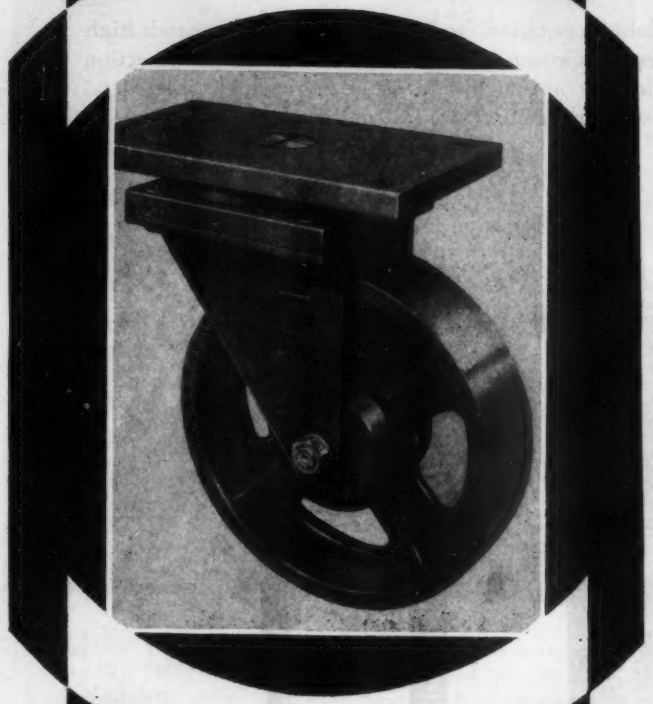
BUY WAR BONDS
...Every fighting dollar is needed

ANACONDA

American Metal Hose

AMERICAN METAL HOSE BRANCH OF THE AMERICAN BRASS COMPANY • General Offices: Waterbury 88, Conn.
Subsidiary of Anaconda Copper Mining Company • *In Canada:* ANACONDA AMERICAN BRASS LTD., *New Toronto, Ontario*

FOR
Maximum
FLOOR
PROTECTION
Specify



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CASTERS & WHEELS
For Savings, Service Safety and Speed—Demand Darnell Dependability. A caster or wheel for every industrial use.

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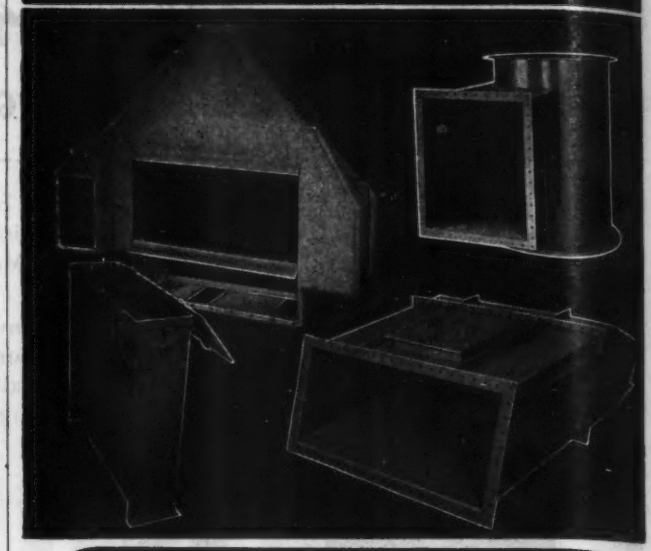
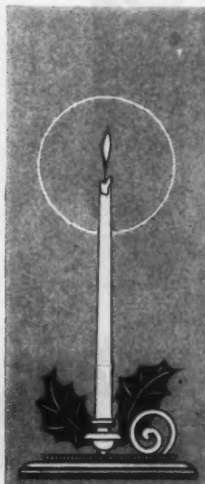
DO YOU NEED HELP?



Are you planning Post War Products? If so, and they are made from plate or sheet steel, Littleford can fabricate them to meet your specifications. Our Engineering Service can help, too. Write for further details.

LITTLEFORD

LITTLEFORD BROS., Inc.
506 E. Pearl St., Cincinnati, Ohio



1869 HAYS 1945

WE are fighting that the Spirit of Christmas may rule the world, and that each Happy New Year may be happier than the last. As we enter the 76th year of our business existence, we feel younger, stronger, and more confident of our own and our country's future prosperity than ever before.

Our seventy-five years of progress have been possible because our own efforts have been backed by the loyalty of our customers and the cooperation of our employees. Without that loyalty and cooperation we could never have accomplished our record of 1944, we could never have won the coveted Army-Navy "E".

So let's join in a toast to the inseparable future success of all three of us; and to the continued Free Enterprise and Free Opportunity which make our success possible.

SPECIALTIES MANUFACTURING DIVISION
HAYS MANUFACTURING CO.
ERIE, PA.

Use COLMONOY

HARD FACING ALLOYS AND OVERLAY METALS

Your production schedules would be mighty easy if your equipment never wore out.

When machinery wears to the point that it is useless for its particular function, you will find that the wear is localized—one place wears out before the rest.

Coat these critical places with the proper grade of COLMONOY. The application is easy to make, by standard welding methods. You will find that parts so treated will give service many times as long as will uncoated parts. Worn and discarded equipment, when hard-faced with COLMONOY not only goes back to work, but outwears and outperforms new, uncoated equipment.

Our new Catalog No. 75 gives full information on all grades of COLMONOY and shows pictures of many types of application in different industries. Write for your copy today.

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Offices in Detroit, New York City, Blasdell, N. Y., Chicago, Tulsa, Los Angeles, San Francisco and in Canada.

CATALOG NO. 75

mailed on request

WALL-COLMONOY CORPORATION

720 Fisher Building · Detroit 2, Michigan

PRESSURIZED CABINS OF THE B-29 MADE SAFE . . .

with REX-FLEX S. S. TUBING

First bomber to have a pressurized cabin, the famous B-29 Superfortress uses Rex-Flex stainless steel tubing in providing supercharged safety for its crew at extreme altitudes.

Boeing engineers began planning years ago to make the B-29 the finest bomber in the world. Every square inch of the huge Superfort's design was carefully scrutinized—each component part, however small, was selected with exacting care.

Boeing engineers knew that the success of the B-29's pressurized cabin would depend upon its ducting system. It had to be safe—non-collapsible, highly resistant to crushing, in order to stand the unbalanced pressures above 30,000 feet. That is why Rex-Flex stainless steel tubing—a product as truly modern as the B-29 itself—was chosen for the job.

Rex-Flex not only has unusual durability but is manually bendable in multiple planes to facilitate installation—and when once installed insures the most leakproof, fireproof and durable ducting suitable for aircraft use. Here is a summary of the reasons why Rex-Flex is the flexible tubing for *your* job:

- *Non-collapsible*
- *High crush strength*
- *Low line loss*
- *Air tight*
- *High vibration quality*
- *Fireproof*
- *Bendable in multiple planes*
- *Corrosion resistant*

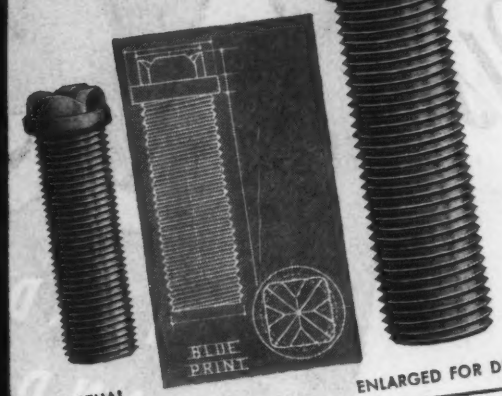
Industry, too, is putting Rex-Flex to work in new and exacting jobs because it has the same endurance as the units used in Superforts. Let us show *you* how Rex-Flex can help in combating corrosion or vibration in your present or post-war products. Write for complete information today.

Flexible Metal Hose for Every Industrial Use

CMH CHICAGO METAL HOSE CORPORATION
MAYWOOD, ILLINOIS
Plants: Maywood and Elgin, Ill.

ANOTHER SPECIAL BY PROGRESSIVE

QUALITY PROMCO BRAND



ACTUAL SIZE

ENLARGED FOR DETAIL

71 other "specials" are illustrated in Catalog 18, which includes tables of weights per 1M standard pieces, dec. equivs. of fractions, etc. Write for it.

Special heads, threads, and finishes — on fastenings of any metal or alloy adapted to cold-upset — are Progressive's specialty. Weekly output: 25,000,000.

The PROGRESSIVE MFG. CO.

★ BONDS BUY MORE WAR BONDS ★

Piezo HINGED GEAR UNIVERSAL JOINT *for the Remote Control of*

VALVES
VENTILATORS
DAMPERS

The LJ Universal Gear Joint is constructed of two matched manganese bronze gears in a hinged housing which permits the operation of shafts at angles from 0 to 92°. It is positive and smooth in action. The self adjusting flexibility of this unit simplifies remote control installations. Write for your free copy of the Piezo catalog.

PIEZOELECTRIC CORPORATION
110 E. 42nd ST., NEW YORK 17, N. Y.

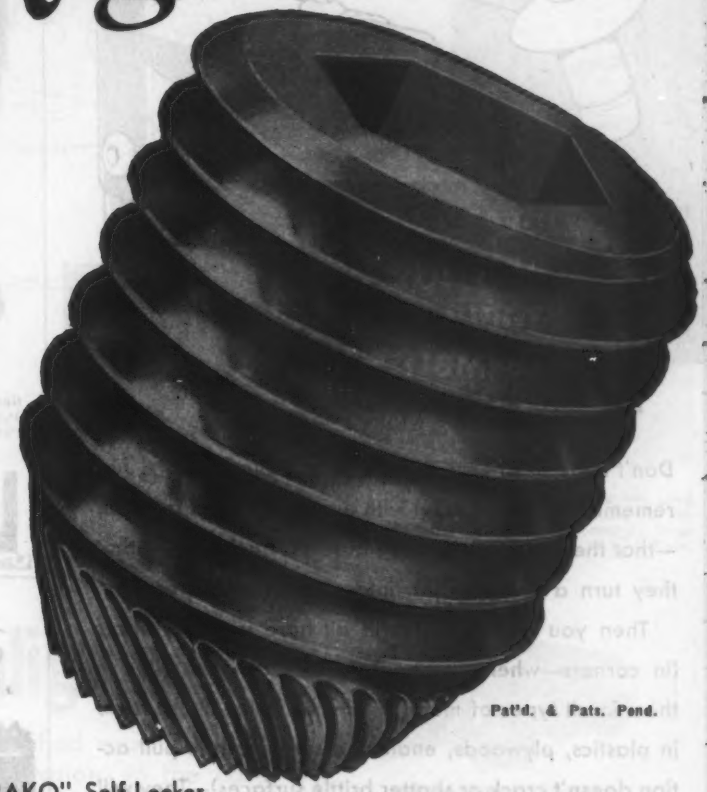
Piezo UNIVERSAL GEAR JOINTS

SOMETHING FOR Designers!

UNBRAKO

Reg. U. S. Pat. Off.

HOLLOW SET SCREW
with the Knurled Cup Point



Pat'd. & Pats. Pend.

It's a Self-Locker and *won't work loose.* The knurls of the point dig in and hold tight. Even so, it is easily backed out with a wrench, and can be used again and again without impairment to its self-locking ability.

This unique locking feature, plus strength, hardness and accurate threading, make the "UNBRAKO" Self-Locker one which you can incorporate with confidence.

For further information send for the "UNBRAKO" Catalog.

Sizes in Hollow Set and Cap Screws from No. 4 to 1½" diameter. Full range of lengths.

And also "UNBRAKO'S" KNURLED SOCKET HEAD CAP SCREW

It's a time-saver. Fingers become geared to the knurls of the head, thereby permitting the screw to be turned farther and faster by hand before a wrench is needed.

Again, a saving in material, weight and cost, are possible with this screw, since its round socket head requires less clearance for application than the ordinary hex head — hence more compact designs.

Patented

"UNBRAKO" HOLLOW SET SCREW WITH KNURLED THREADS

Where the "Unbrako" Cup Point Self-Locker is not suitable, use our Knurled Thread "Unbrako," which, regardless of the style of point, is also a Self-Locker. Magnified section of cut at left shows the locking feature and angle of knurls. These positively prevent the screw from unwinding once it has been set.

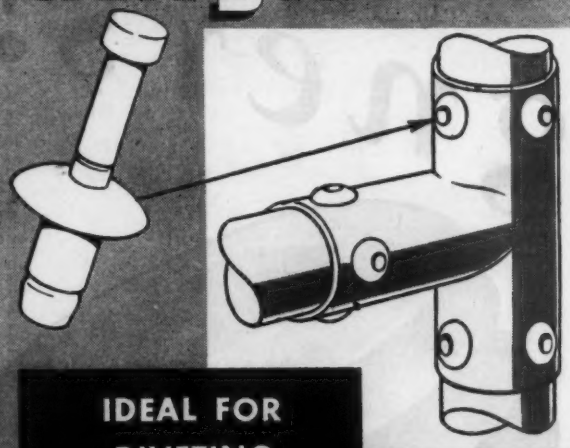
OVER 40 YEARS IN BUSINESS

Knurling originated with "Unbrako" years ago

STANDARD PRESSED STEEL CO.

JENKINTOWN, PENNA., BOX 545 • BRANCHES: BOSTON • DETROIT • INDIANAPOLIS • CHICAGO • ST. LOUIS • SAN FRANCISCO

CUT PRODUCTION COSTS WITH Cherry Rivets



IDEAL FOR RIVETING TUBULAR ASSEMBLIES

Don't think of Cherry Rivets only as "blind" rivets. Just remember they are upset with a *pull instead of a pound* —that they need no bucking bar—no backing up—that they turn a *two-man* job into a *one-hand* operation.

Then you will use them in all hard-to-get-at spots (in corners—wherever space is limited). You will use them in all types of metal structures; you will use them in plastics, plywoods, enameled surfaces (the pull action doesn't crack or shatter brittle surfaces)—They will work in soft materials (rubber, leather, fabric) without bending, buckling or tilting the rivet.

With Cherry Rivets, short runs become production jobs without tooling or special set-up. Remember, too, that Cherry Rivets have wide tolerance in hole size and grip length—are fast to use and most economical.

See for yourself how Cherry Rivets can cut production costs in your plant. Write for Handbook A-43. Address Department A-106, Cherry Rivet Company, 231 Winston Street, Los Angeles 13, California.

CHERRY RIVETS, THEIR MANUFACTURE AND APPLICATION ARE COVERED BY U. S. PATENTS ISSUED AND PENDING

Cherry Rivet Company
LOS ANGELES, CALIFORNIA

with an Eye to the FUTURE

Gusher Pumps Patented and Pat. Pending

MODEL 11020-A

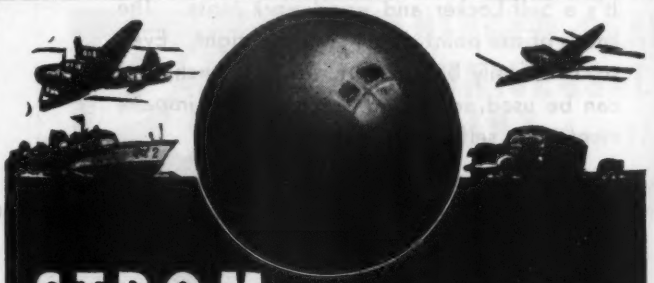
The Ruthman engineering staff are continually conducting experiments and research toward new developments and improvements in

GUSHER COOLANT PUMPS

The new models are so advantageous in operation that many plant engineers have re-designed or are re-designing their machine-tools to include them. By actual test these newer type Ruthman pumps have *proven* their superiority.

Write for new catalog, indexed for ready reference. Remember, there is a Gusher model and type for your special needs.

THE RUTHMAN MACHINERY CO.
1809 READING ROAD CINCINNATI 2, OHIO
The "Gusher" — A Modern Pump for Modern Machine Tools



STROM STEEL BALLS

NOW AT WAR—LATER IN PEACE

Strom Metal Balls are now being used in the instruments of war. But in the peace to come, they will again be dedicated to the building of a better brighter world.

Largest independent and exclusive Metal Ball Manufacturer.

STROM STEEL BALL CO.
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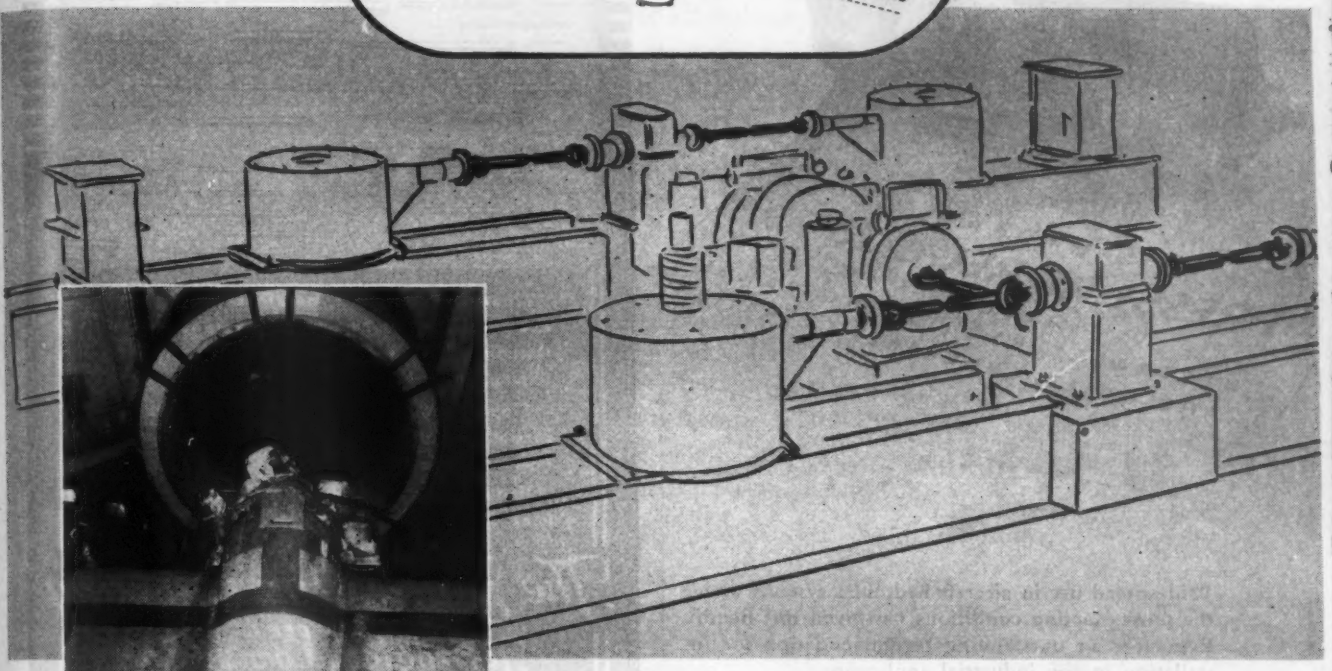
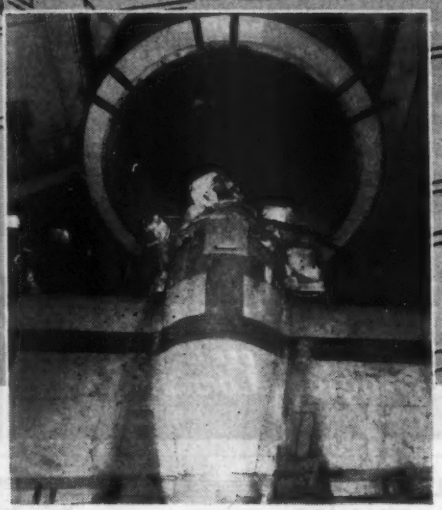
A PROBLEM IN . . .

TAKING POWER AROUND CORNERS





(Photo at left by Air Technical Service Command)

ABOVE: Sketch of elevator mechanism used to facilitate access to plane sections in the Air Technical Service Center Command's huge 20 foot wind tunnel (at Left), Wright Field, Ohio.

A Chance For Misalignment?

Universal joints can be the answer to simplified machine design, economical construction and trouble-free operation. In the case of the elevator mechanism above, absolute rigidity and constant in-line power delivery shafts would demand bulky, costly and intricate design — but the application of Blood Brothers Universal Joints not only eliminates those necessities, but also insured steady, smooth, efficient power delivery.

DESIGN ENGINEERS: We welcome your design problems concerning transmission of power through angularity or misalignment. Our 30 years of experience are at your disposal.

AUTOMOTIVE TYPE

FARM EQUIPMENT TYPE

CONSTRUCTION EQUIPMENT TYPE

POWERED MACHINERY TYPE

FREE ENGINEERING DATA: Write Dept. 12 for Blood Engineering Bulletins and specifications on all Blood Joints.

BLOOD BROTHERS

UNIVERSAL JOINTS

FOR EVERY NEED OF POWER THROUGH ANGULARITY

BLOOD BROTHERS MACHINE CO. ALLEGAN • MICHIGAN
DIVISION STANDARD STEEL SPRING CO.

Widespread use in aircraft hydraulic systems under the most exacting conditions has given this Bendix Regulator an outstanding recommendation for installation in any industrial application.

The Bendix Regulator is of the relay type and is noted for its desirable regulating range between cut-in and cut-out pressures, quiet operation and freedom from hydraulic shocks. The design incorporates plastic poppet valves which show less leakage, less sensitivity to foreign particles in the fluid, stability of regulating range at various flow rates and unexcelled long life.

Installed in a 1000 PSI system the regulator can be set, for example, to cut-in at 800 PSI and cut-out at 1000 PSI. The unit will regulate pressures up to 1500 PSI and has a maximum flow capacity of 10 G.P.M.

Write Department 7, Pacific Division of Bendix today for complete data, indicating the conditions under which you are interested in using the Regulator.

Other hydraulic controls manufactured by Pacific Division include selector valves, shutoff valves, flow equalizers, accumulators, actuating cylinders and check, relief, restrictor and sequence valves.

Pacific Division
BENDIX AVIATION CORPORATION

NORTH HOLLYWOOD, CALIFORNIA

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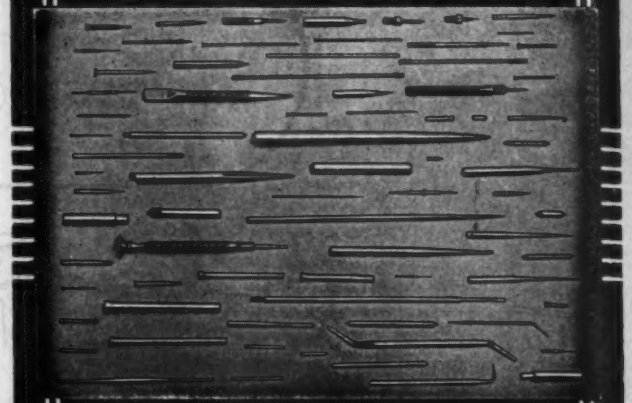
MADE TO ORDER



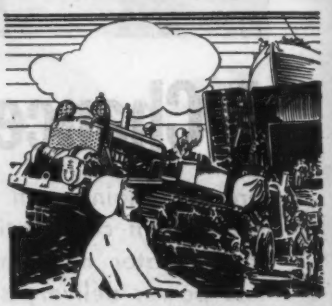
Unusually accurate metal parts including operations such as heading, rotary swaging, roll threading, fluting, knurling, pressing, milling, turning, grinding, forming, etc.

Single and double tenon studs turned on specially designed machines, held to close diameter tolerances, with no cut-off burrs.

Uniform heat treatment assured with the very latest equipment.

The Torrington Company
SPECIALTY DEP'T.
Torrington, Conn., U.S.A.

HOW DIESEL TRACTOR Power Transmission WILL HELP GIVE More Horsepower To TOMORROW'S TRUCKS

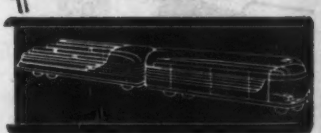


Hauling heavy equipment up sandy beaches, filling in shell craters and brushing away jungle growth has developed clutches that will enable tomorrow's truck trains to haul the heaviest loads over the roughest roads. Let our engineers show you how you can improve your post-war models by using these

ROCKFORD SPRING LOADED CLUTCHES

SEND FOR THIS HANDY BULLETIN ON POWER TRANSMISSION CONTROL

It tells and shows how ROCKFORD CLUTCH and POWER TAKE-OFF applications are saving time, power and money in transport equipment and a wide variety of industries. Gives capacities, dimensions and specifications.



They provide for instant pick-up, convenient power transmission control and smooth gear shifting—with disengagement maintained by light foot-pedal or hand-lever pressure.

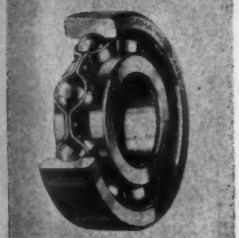
ROCKFORD DRILLING MACHINE DIVISION Borg-Warner Corporation
209 Catherine Street, Rockford, Illinois, U. S. A.

Pullmore Multiple-Disc Clutches • Over-Center and Spring-Loaded Clutches • Power Take-Offs

VICTORY, first: THEN—

PRECISION BEARINGS FOR EVERY PURPOSE, INDUSTRIAL AND DOMESTIC

Separable (Magneto) Ball Bearing



Single Row Ball Bearing

War's demands still call for all the output of the NORMA-HOFFMANN factory. But, already, far-sighted manufacturers are working with NORMA-HOFFMANN engineers on their designs for new and better peace-time products equipped with PRECISION BEARINGS.

No "Re-conversion Problem" will hamper or delay NORMA-HOFFMANN post-war production. The moment peace is declared, all our vast facilities will be turned INSTANTLY to the production and prompt delivery of PRECISION BEARINGS for new and better domestic appliances and for new and better tools for industry.

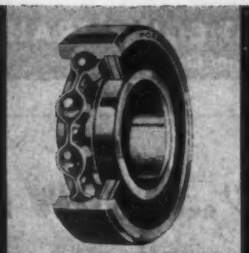
Our Field Engineers, in all our District Offices, are ready to work with YOUR designers. Avail yourself of their experienced counsel NOW—without obligation, and of course in strict confidence. *Write for the Catalog—Today.*

TO WIN THE WAR: WORK—FIGHT—BUY WAR SAVINGS BONDS!

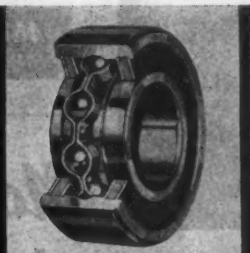
Litro ("CL") Composition Retainer Ball Bearing

Double Row Self-Aligning Ball Bearing

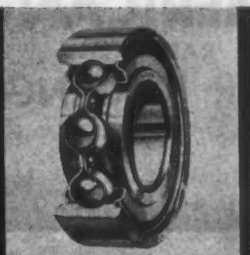
Shielded Type Single Row Ball Bearing



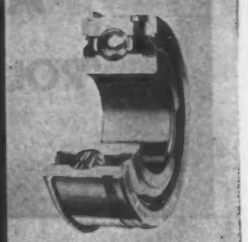
Single Felt Seal Ball Bearing



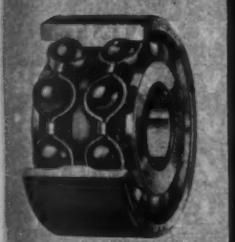
Double Felt Seal Ball Bearing



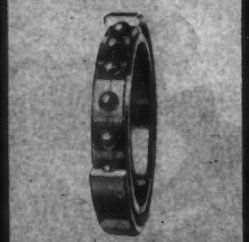
9000 Series (Feltless) Sealed Ball Bearing



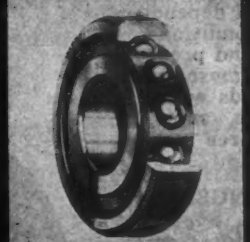
"Cartridge" Fully Sealed, Refillable Type Ball Bearing



Double Row Ball Bearing

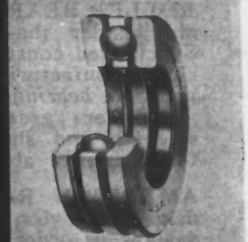


Extra Light Type Ball Bearing

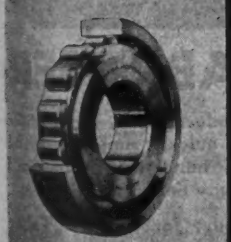


Angular Contact Ball Bearing

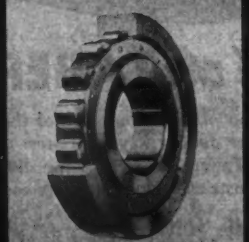
Extra Light Single Direction Ball Thrust Bearing



Single Direction Ball Thrust Bearing



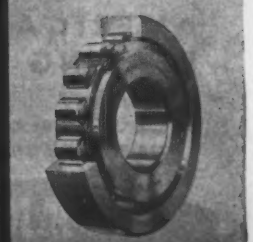
Standard Cylindrical Roller Bearing



Type "E" Cylindrical Roller Bearing

Full Type (Retainerless) Cylindrical Roller Bearing

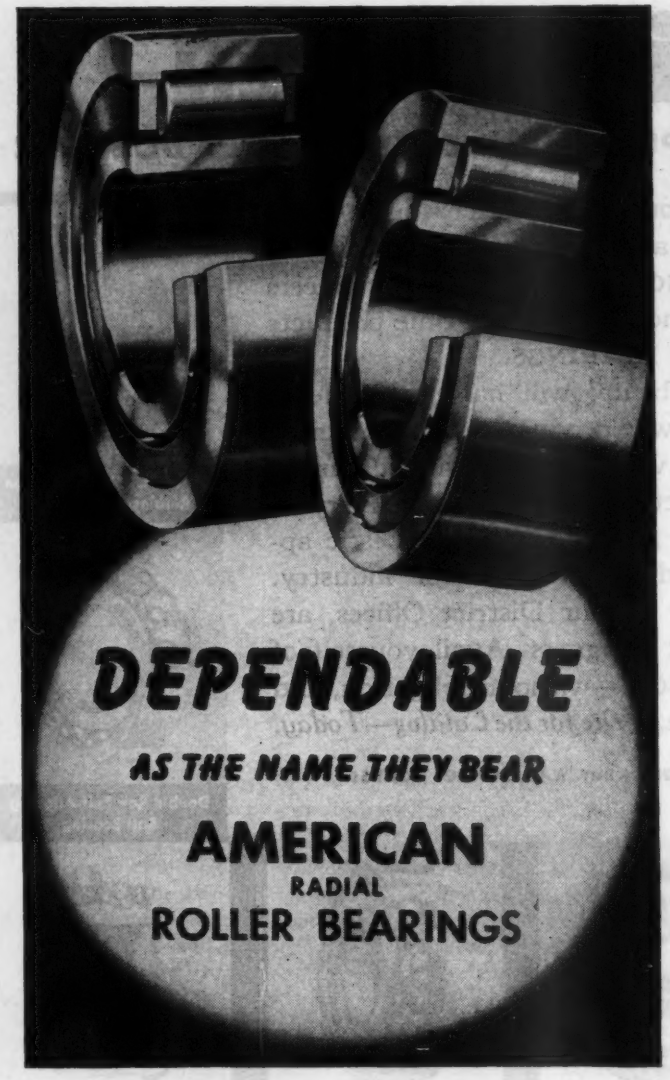
Extra Light Cylindrical Roller Bearing



Two-Lipped Cylindrical Roller Bearing

NORMA-HOFFMANN BEARINGS CORP'N. STAMFORD, CONN. *Founded* 1911

Field Offices: NEW YORK • CHICAGO • CLEVELAND • CINCINNATI • PITTSBURGH • DETROIT • LOS ANGELES • SAN FRANCISCO • SEATTLE, WASH.



Engineered specifically for extra heavy duty applications where the load is *radial*, AMERICAN RADIAL ROLLER BEARINGS function smoothly and dependably under the most exacting service conditions. Specialized construction, flawless materials and precision manufacturing, set them apart as *the most dependable bearings yet designed* for radial loads where strains are greater . . . where toughness, superstrength and smooth, continuous, trouble-free performance are absolute requisites.

AMERICAN RADIAL ROLLER BEARINGS are made in 5 styles, 4 S.A.E. series and 85 sizes. Special designs to order are also available. Write for complete data or send us your requirements for analysis and recommendations.

AMERICAN ROLLER BEARING COMPANY
Pittsburgh Pennsylvania
Pacific Coast Office
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COIL AND TRANSFORMER COR
Announcing!
Our new plant is now in full production, greatly increasing our capacity. We believe it to be the most modern and efficient unit now engaged in the production of transformers, coils and allied electronic equipment.
Please take note of our new address, where you will always receive a cordial welcome.
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Whether you *make* or *buy* any of the products listed, you'll make or buy *better quality* if you pre-test them quickly, simply with the marvelous Taber Abraser. Now used by hundreds of America's leading industries. Soon earns its cost many times over.

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Using Sems Units makes the entire assembly operation faster and more efficient with the assurance of locked-tight parts. Sems Units help solve many other assembly line problems especially by eliminating unnecessary, time-wasting operations. Shakeproof Engineers can prove these advantages and show you the most practical way of using this fastening on your products. Write today . . . a field engineer will consult with you immediately!

SEMS FASTENER UNITS

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Pre-Assembled Shakeproof Lock Washer and Screw

Worker can't "forget" the lock washer • Lock washer can't drop off • No lost or wasted lock washers • Only one unit to handle • Saves time • Speeds assembly

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LOOK INTO GAST ROTARY AIR MOTORS

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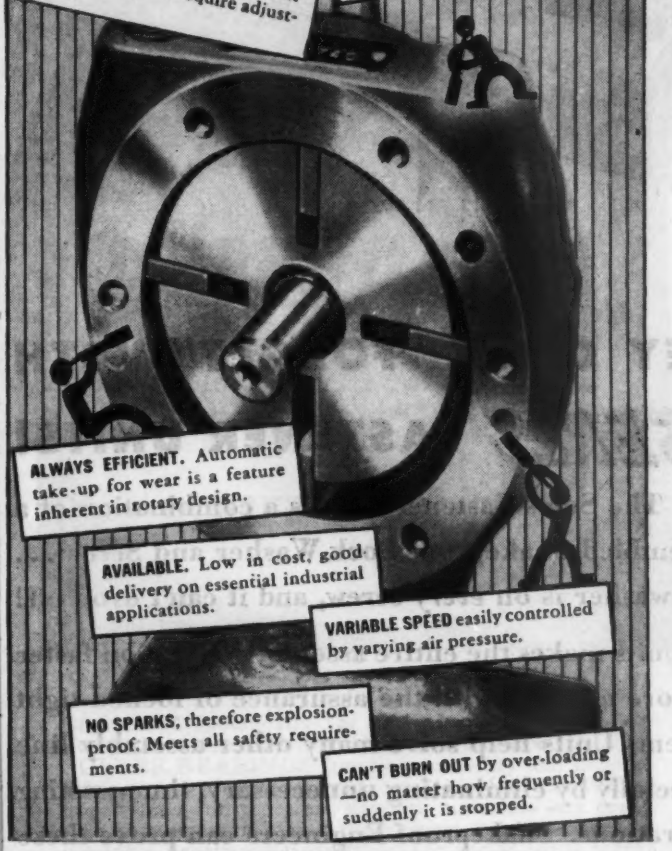
SIMPLE, trouble-free operation. No springs behind vanes, shaft packing does not require adjustment.

COMPACT. Unbelievable power in proportion to small size.



ALWAYS EFFICIENT. Automatic take-up for wear is a feature inherent in rotary design.

AVAILABLE. Low in cost, good delivery on essential industrial applications.

VARIABLE SPEED easily controlled by varying air pressure.

NO SPARKS, therefore explosion-proof. Meets all safety requirements.

CAN'T BURN OUT by over-loading —no matter how frequently or suddenly it is stopped.

● Investigate for yourself why so many manufacturers are using Gast Rotary Air Motors in explosion-proof applications and others where compressed air is available—both in their own plants and as part of machines they manufacture.

You will find that Gast Air Motors have many special advantages, including those inherent in Rotary design. A few are shown here. For the complete "inside story" send for the new descriptive folder "Industry's Trend to Air for Power".

If you are designing or building machines or devices where air motors are being considered, why not order

A SAMPLE MOTOR FOR TEST

or let us have one of our engineers call on you for the purpose of helping you determine how Gast Rotary Air Motors may be used to improve performance. Write, phone or wire.

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MOTORS • COMPRESSORS

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A 2-POINT SERVICE FOR YOUR POST-WAR HYDRAULIC NEEDS

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SPECIALISTS IN HYDRAULICS

In lining up your post-war schedules, it will pay you to utilize Adeco experience and facilities. These specialists in hydraulics can help you in two important ways:

1 Assist you in designing hydraulic mechanisms to meet your requirements.

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An illustrated booklet presents the story behind this Adeco service. Write for your copy today.

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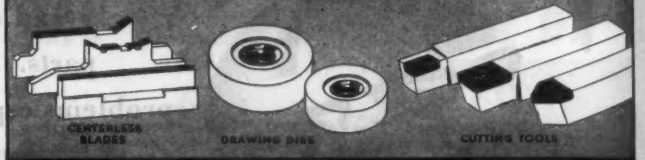
METAL CARBIDES CORPORATION · YOUNGSTOWN, OHIO



METAL CARBIDES CORPORATION

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SYNCHRO-START *AUTOMATIC ENGINE* **CONTROLS**

AN AUTOMATICALLY CONTROLLED GAS, GASOLINE or DIESEL ENGINE

Is the Best Answer To Your Power Problem

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SYNCHRO-START PRODUCTS

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WHY MORE FORGINGS IN YOUR POST-WAR PRODUCTS ?

The advantages of the broader use of forgings have proved themselves in armament making to such an extent that the nation's forge facilities were taxed to their utmost during the peak war production period. These same advantages are being utilized by designers of postwar machines and equipment.

HIGH TENSILE STRENGTH

Forgings provide metals at their ultimate strength and toughness, with maximum resistance to tensional, torsional and compression stresses; obtained through controlled grain flow, resulting from the forging process. Forged parts also embody the high fatigue resistance which results in longer service life.

SAVINGS IN WEIGHT

The forging process produces maximum strength, permitting use of thinner metal sections, resulting in parts of less weight. Valuable space may also be saved. These are important considerations in many postwar machines.

LOWER MACHINING COSTS

With the close tolerances obtainable by modern day methods, forgings generally require less time to machine and finish; resulting in reduced machining and tool costs.

GREATER SAFETY

The fracture of a part is too often accompanied by a serious accident. The use of forgings for stressed parts affords the highest safety factor.

At Kropp Forge, facilities for essential civilian forgings are becoming available as our war assignments are completed.

When you need flat die, drop or upset forgings, call the nearest Kropp engineering representative, or write direct for information or quotation.

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ARMY ★★ E ★★ NAVY

4-STAR FEATURE

SHERWIN-WILLIAMS helps develop a four-feature pro-coating enamel for the U.S. Quartermasters Corps

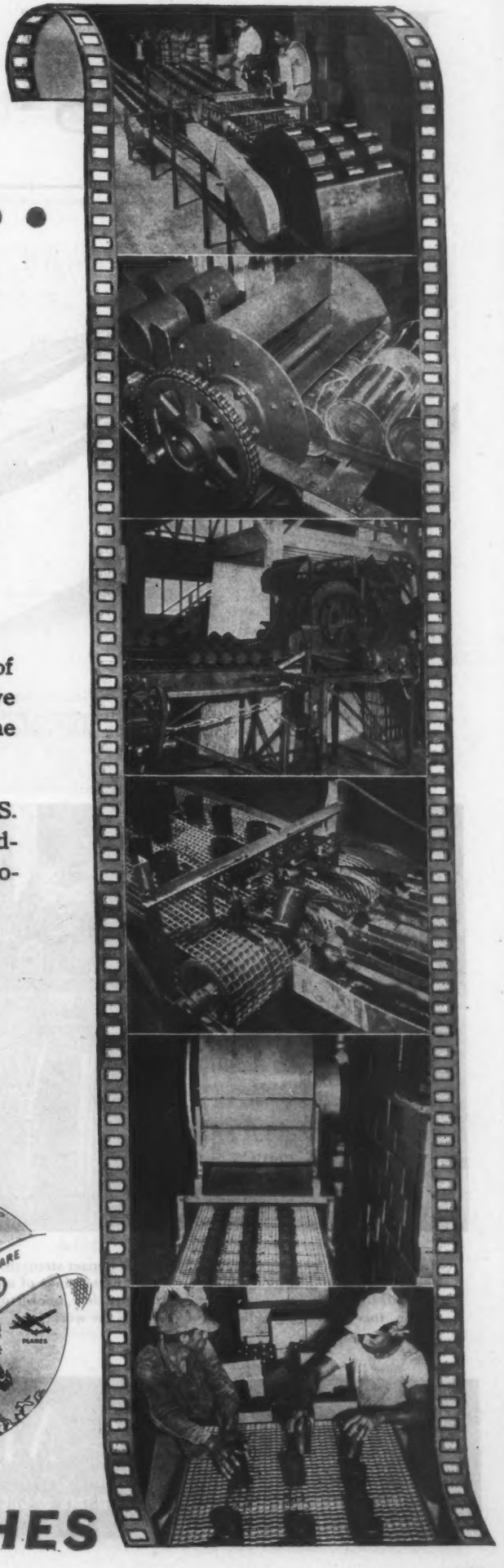
DEFEATING THE RISING SUN

These jungle fighters take time out to rest and eat. Notice the absence of any reflective metallic surfaces. Even the tin can is camouflaged by pro-coating because, left shiny, enemy air reconnaissance could estimate the number and concentration of troops by the number of discarded tin cans.

Official U. S. Signal Corps Photo

SHERWIN-WILLIAMS

FILM . . .



1 FEATURE It protects against the corrosive action of moisture and salt.

2 FEATURE It has a hard, smooth finish that stands up under bumping and knocking during packing and shipping.

3 FEATURE It has a non-reflective surface.

4 FEATURE It speeds up drying time from five minutes to as short as one-and-three-quarter minutes.

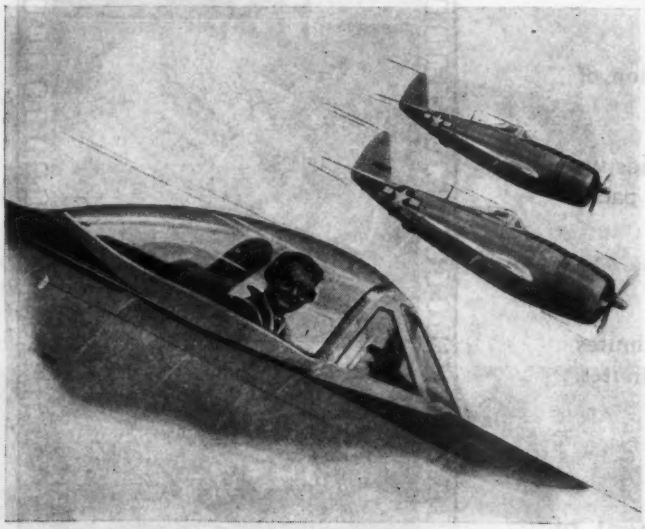
The last important step, prior to actual shipment of canned foods overseas, is the application of a protective film of tough, non-corrosive, non-reflective enamel to the exterior of the can.

Because no such finish was available, the U. S. Quartermasters Corps commissioned the country's leading paint manufacturers through their National Association to develop one.

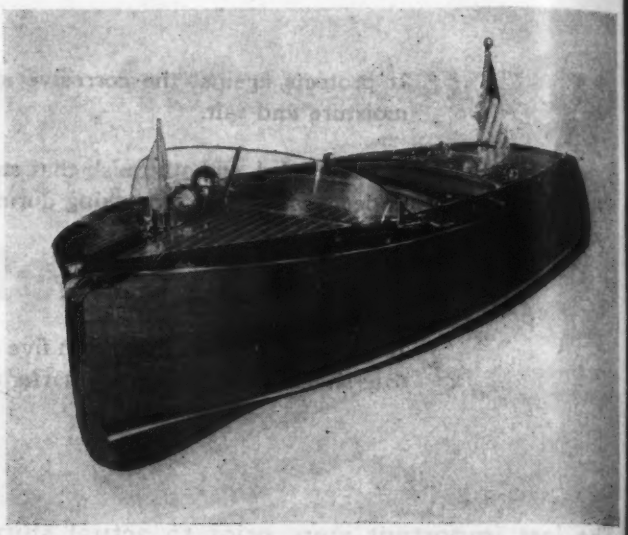
Sherwin-Williams soon came up with an answer . . . an enamel that is practically "foolproof" . . . that handles so easily it can be applied by canners with existing equipment in all seasons and all climates . . . that can be forced-dried or air-dried. Here is another example of how Sherwin-Williams handles a finishing problem. The same thorough service is also available to you. Write the Sherwin-Williams Co., Cleveland 1, Ohio.

INDUSTRIAL FINISHES

Plexiglas—*the plastic that*

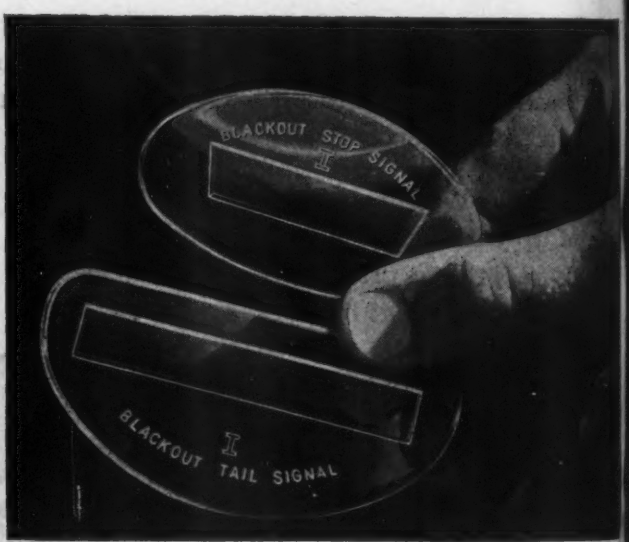


The high strength of PLEXIGLAS permits its fabrication into large unsupported structures which are subjected to severe stresses in service. A typical instance is the one-piece "bubble" canopy that protects the pilot on the Republic Thunderbolt.



Used in spray shields, windows, and light covers on boats, PLEXIGLAS withstands the weaving and stresses of the superstructure in heavy seas. Unaffected by salt water, sunlight and weathering, PLEXIGLAS retains its high transparency indefinitely.

In this safety shield PLEXIGLAS provides high impact strength, and is proof against splintering when struck by flying chips of metal. With its high transparency, PLEXIGLAS permits clear, unobstructed vision, together with excellent protection for the worker.



PLEXIGLAS molded parts successfully absorb repeated impacts and flexing, even when subjected to such severe service as these black-out lenses, which are used on Army trucks that must move rapidly over rough terrain.

ROHM & HAAS

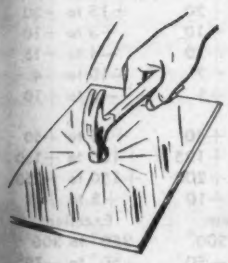
Manufacturers of Chemicals including Plastics . . . Synthetic Insecticides . . . Fungicides

combines Transparency with Strength

THE permanent crystal-clarity of PLEXIGLAS naturally suggests its adoption in a wide variety of industrial products and parts where transparency is necessary—or desirable.

Equally important to the product designer are the excellent mechanical properties of this Rohm & Haas acrylic plastic—fully demonstrated properties which assure its successful performance in the fields of application opened by its transparency.

1. Impact strength of PLEXIGLAS is exceptionally high

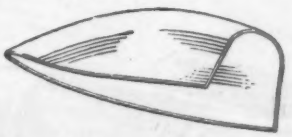


The ability of PLEXIGLAS to withstand severe impact is of particular value in applications where breakage would be costly, inconvenient or hazardous. When held rigidly and subjected to heavy blows, PLEXIGLAS does break, but only into large, dull-edged pieces.

2. PLEXIGLAS has lasting strength

The excellent mechanical properties of PLEXIGLAS—like its transparency—are permanent, practically unaffected by extended flexing, weathering, low temperature or water immersion. New heat resistant formulations have recently increased the service temperature range for PLEXIGLAS parts.

3. Rigidity permits use of PLEXIGLAS in self supporting parts



PLEXIGLAS is flexible, but its modulus of elasticity is high enough (3 to 4 x 10^5) so that it can be used in secondary or self-supporting structures and housings. Among thermoplastics PLEXIGLAS also is exceptional in its low cold flow or creep.

LOOKING AHEAD THROUGH

Plexiglas

Rohm & Haas is the pioneer and principal producer of acrylic plastics. Today PLEXIGLAS is found on every type of Army and Navy plane—convincing proof of the qualities that have made it "aviation's standard transparent plastic."

Why not investigate the ways in which it can give *your* product new sales advantages? Write or call our nearest office—Philadelphia, Detroit, Los Angeles, Chicago, Cleveland, New York. Canadian Distributor, Hobbs Glass Ltd., Montreal.

Only Rohm & Haas makes

PLEXIGLAS

CRYSTAL-CLEAR ACRYLIC SHEETS AND MOLDING POWDERS*

*Formerly CRYSTALITE Molding Powders

PLEXIGLAS is the trade-mark, Reg. U. S. Pat. Office, for the acrylic resin thermoplastic sheets and molding powders manufactured by Rohm & Haas Company.

Represented by Cia. Rohm y Haas, S R. L. Carlos Pellegrini 331, Buenos Aires, Argentina, and agents in principal South American cities.

S O M P A N Y

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Enzymes . . . Chemicals for the Leather, Textile, Enamelware, Rubber and other Industries

Properties of HYCAR

oil-resistant synthetic rubbers

With broader use now permitted, this table should suggest applications in your business

IT is impossible to tell the whole HYCAR story in one page. However, the table at the right can serve to give you some idea of what properties can be had in Hycar compounds and suggest certain combinations of properties that would answer a specific problem for you.

PROPERTIES OF TYPICAL HYCAR COMPOUNDS	OR-15	OR-25
Specific Gravity	1.15 to 1.35	1.15 to 1.35
Tensile Strength (Maximum) p.s.i.	4500	3500
Tensile Strength (Average) p.s.i.	1500 to 3000	1000 to 2500
Elongation at Break—%	100 to 800	100 to 700
Hardness, Shore Durometer, Type A	10 to 100	10 to 100
Oil and Solvent Resistance.....Percent Volume Change after Immersion:		
Kerosene—48 hours at room temperature	−3 to +4	+1 to +12
Gasoline—48 hours at room temperature	−3 to +2	−4 to +10
Aromatic Fuel—168 hours at room temperature	+10 to +20	+15 to +30
Ethyl Alcohol—48 hours at room temperature	+3 to +10	+3 to +10
Ethylene Glycol—70 hours at 212° F.	−5 to +10	−4 to +15
SAE 20 Lub. Oil—168 hours at 212° F.	−10 to +2	−10 to +4
Hydraulic Oil—168 hours at 212° F.	−10 to +5	−5 to +10
Carbon Tetrachloride—48 hours at room temperature	+25 to +40	+35 to +50
Benzene—48 hours at room temperature	+75 to +125	+100 to +150
Acetone—48 hours at room temperature	+100 to +200	+150 to +250
Distilled Water—70 hours at 212° F.	0 to +10	+8 to +18
Abrasion Resistance	Excellent	Excellent
Maximum Service Temperature, degrees F.	250° to 300°	250° to 300°
Minimum Flexibility Temperature, degrees F.	−30° to −50°	−50° to −70°
Compression Set—ASTM Method B—Percent	8 to 22	5 to 20
Age Resistance	Excellent	Excellent
Sunlight Resistance	Fair	Fair
Resilience—Lupke Rebound, percent energy recovered	20 to 50	30 to 60
Coefficient of Expansion, inches per inch per deg. F.	0.00043 to 0.000095	

While Hycar's climb to fame originally developed from its superb oil resistance, its applications have grown vastly due to its many other outstanding properties—abrasion resistance, age resistance, low compression set, wide temperature service range, resilience, and many others. And Hycar can be blended with vinyl resins to produce compounds with additional favorable characteristics.

Hycar is now available both for experiment and for production of any essential product. Our Technical Service Staff will be glad to help you with your individual problems. *Hycar Chemical Company, Akron 8, Ohio.*

Hycar

Reg. U. S. Pat. Off.

LARGEST PRIVATE PRODUCER OF BUTADIENE TYPE

Synthetic Rubber

Free—write for your copy of the new pocket-size Hycar Glossary of commonly used synthetic rubber terminology.

Automobile bumpers, cold-formed from N-A-X HIGH-TENSILE STEEL, illustrate the ability of this fine alloy to take the stresses of a critical cold-forming operation. Result: a tougher, more satisfactory product at reduced fabricating costs.

THIS HIGH-TENSILE STEEL "TAKES OVER" WHERE DRAWING STRESSES ARE TOUGH

N-A-X HIGH-TENSILE STEEL has stepped into some tough spots in the production of intricate shapes. It has proved to production men that here is a great steel to work with, from the standpoints of both manufacturing operations and finished performance.

To put it in a few words, N-A-X HIGH-TENSILE STEEL has what it takes to make a stronger, tougher product through more efficient production methods. Its exceptional ductility and resistance to impact, inherent in the fine grain structure of a great alloy, often make possible the speed and economy of cold-forming on pieces which must be worked hot when other grades of steels are used. And where critical drawing stresses require hot work, N-A-X HIGH-TENSILE STEEL provides the important advantage of maintaining its high physical properties with minimum cooling distortion even after it has been subjected to a wide range of temperatures. No subsequent treatment is needed to maintain "as rolled" specifications.

Add to these advantages the high fatigue life and resistance to corrosion and abrasion that qualify N-A-X HIGH-TENSILE STEEL for varied types of applications, and you'll see why this fine-grain, low-alloy steel is a factor in postwar planning. Great Lakes Steel metallurgical service is yours on request: Let's have your problem.

GREAT LAKES STEEL
Corporation

DETROIT 18, MICHIGAN • SALES OFFICES IN PRINCIPAL CITIES
Division of NATIONAL STEEL CORPORATION. Executive Offices, Pittsburgh, Pa.

GREAT STEEL FROM GREAT LAKES

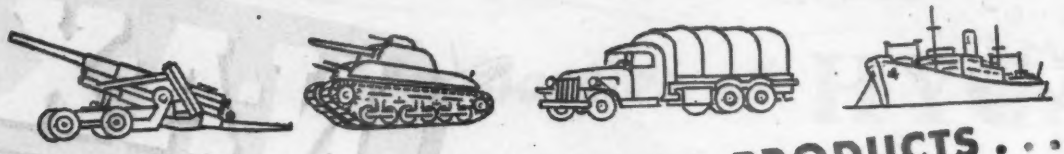
HIGHLIGHTS OF N-A-X ALLOY STEEL

N-A-X HIGH-TENSILE STEEL compares favorably with other low-alloy high-tensile steels in yield and tensile strength, with outstanding ductility and notched bar values. In applications where it replaces mild-carbon steels, it serves to reduce weight or increase strength through the utilization of these properties in design.

Another property that may interest you is the excellent weldability of N-A-X HIGH-TENSILE STEEL—whether welded to itself or to other high-tensile or structural steels of welding quality.

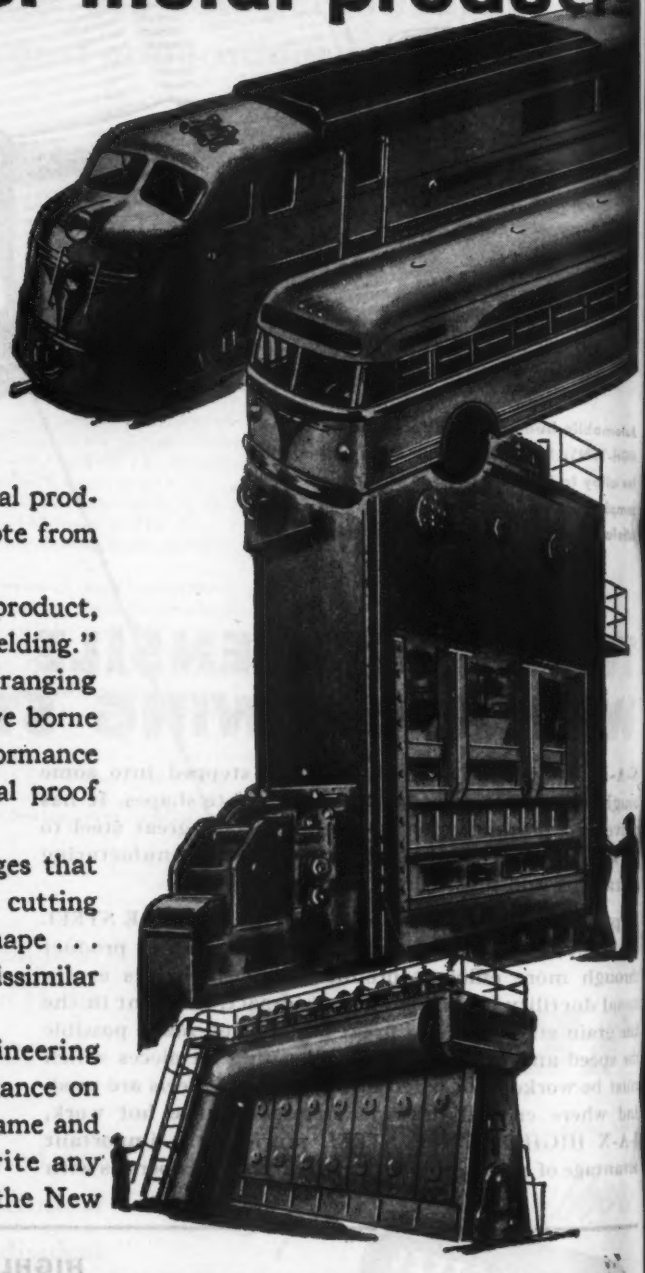
N-A-X 9100 SERIES STEELS are produced in carburizing and constructional grades. Except for carbon, they have a chemical analysis that is constant within definite ranges. Together with X-9100 Series steels, containing molybdenum, they provide hardenability ratings to cover a wide variety of requirements, yet give an all-purpose analysis to yield properties. Molybdenum confers great depth hardenability to extend the usefulness of the N-A-X 9100 Series, which are medium-hardening steels.

N-A-X ARMORPLATE is an example of the exacting requirements that Great Lakes can meet with this low-alloy series. One of the X-9100 Series steels is the basis of the armor we produce for tanks, armored cars and practically all landing craft.



LIKE THESE PROVEN WAR PRODUCTS . . .

Peacetime's better metal products *will be* FLAME-CUT *and* WELDED



DESIGNERS who are now planning peacetime metal products and machines will be wise to take this note from the war designer—

"For a stronger, lighter, better-looking metal product, design it for construction by flame-cutting and welding."

Hundreds of flame-cut and welded war products, ranging from tiny aircraft parts to massive cargo ships, have borne out the wisdom of this statement. And their performance in the tough proving ground of battle gives factual proof of their superiority.

Flame-cutting and welding offer many advantages that every designer should consider . . . fast, economical cutting of steel of any section into any regular or irregular shape . . . flexibility, speed and economy in joining similar or dissimilar metals into a strong, "one-piece" unit.

Representatives of Air Reduction's Field Engineering Division will be glad to give you all possible assistance on the use of the oxyacetylene flame and the electric arc. Call or write any Airco office or Dept. PD, at the New York address.

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Advertisement DECEMBER, 1944

COPPER ALLOY BULLETIN

REPORTING NEWS AND TECHNICAL DEVELOPMENTS OF COPPER AND COPPER-BASE ALLOYS

Prepared Each Month by the Bridgeport Brass Co. "Bridgeport" *Headquarters for BRASS, BRONZE and COPPER*

Non-Ferrous Hot Forgings Versus Castings For Better Engineering Properties

The tremendous strides made in engineering, so necessary for successfully conducting modern warfare, will be reflected in the production of better peacetime products in the postwar period. Today, engineers are more conscious of material specifications. They are concerned not only with the composition of the material or alloy used but also with its physical condition...whether in the form of a casting, stamping, cold forging, or hot forging. It follows, therefore, that engineers favor hot forgings over castings because of their superior engineering properties.

Forgings have a much higher tensile and yield strength than castings because of their refined microstructure and freedom from porosity. Furthermore, they can be held to uniform, precise dimensions and close tolerances—requiring less machining. Perhaps the most important advantage of forgings over castings is the fact that there are fewer rejections after final inspection and lower finishing costs, which insure economy of manufacture plus dependability. Forgings, therefore, are specified where service requirements are very severe and exacting, as for example: safety devices, pressure fittings and other parts which must not fail from fatigue or hidden weaknesses.

Non-ferrous forgings, because they do not deteriorate from rusting, are superior to ferrous forgings which must be treated by galvanizing or by the application of some other surface finish to retard corrosion from moisture and the elements. The range of non-ferrous forging alloys available makes possible a large variety of physical properties such as high tensile and yield strength, easy machinability, high impact strength; also, good sound surfaces which will take an attractive, lasting finish and pleasing colors.

Non-ferrous forgings are not necessarily weaker than ferrous forgings. For example, a mild steel forging has a tensile strength of approximately 60,000 pounds per square inch, which is similar to that of Naval Brass. An alloy like DURONZE III, whose tensile strength as a forging is between 85,000 and 90,000 pounds per square inch, is about 50% stronger than mild steel. DURONZE III is excellent for the manufacture of gears, pinions, thrust screws, sliding parts, and similar items because of its generally low coefficient of friction when in moving contact with steel or other metals. Maintenance men have found that wear and tear on heavy duty machinery can be reduced considerably by replacing many steel parts with DURONZE III. Forged Valve Stems from DURONZE III outlast steel and brass because of reduced wear and greater strength and corrosion resistance.

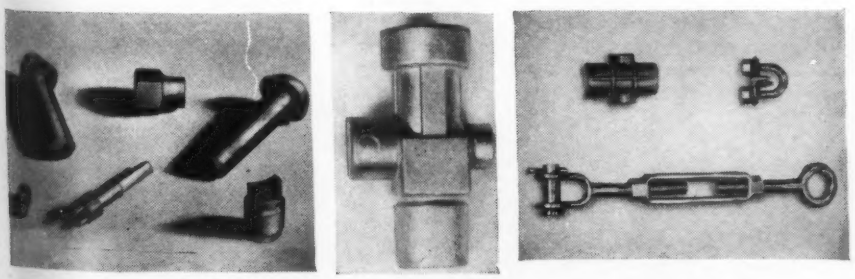
The mechanical and physical properties of six Bridgeport Brass forging alloys are shown in tabular form herewith. These data should be filed away for future reference. Reprints of this issue and most of the back issues of the COPPER ALLOY BULLETIN will be supplied upon request.

NON-FERROUS RODS FOR HOT FORGING

	Duronze III	Duronze II	Bpt. Forging Rod	Naval Brass	Manganese Bronze	Muntz Metal
ANALYSIS						
Copper %	91.0	97.03	59.50	60.0	58.5	59.75
Lead %		2.85 Silicon	1.75	.15		
Tin %		0.12 Iron	.20	.75	0.75	
Zinc %			38.55	39.1	39.45	40.25
Iron %	7 Aluminum				1.0	
Manganese %	2 Silicon				.3	
MECH. PROP. AS HOT FORGED (Average Values)						
Tensile Strength, psi.	90,000	55,000	55,000	60,000	68,000	56,000
Yield Strength, psi. .5% Ext.	45,000	24,000	20,000	24,000	30,000	21,000
Elongation, % in 2"	30	35	35	30	30	35
Rockwell Hardness	B85	B65	B50	B58	B67	B50
PHYSICAL CONSTANTS						
Melting Point (Liquidus) °F	1,810	1,895	1,640	1,650	1,630	1,660
Density, Lb./cu. in.	.278	.309	.305	304	.302	.303
Coeff. of Thermal Expansion per °F from 77°F to 572°F x 10^{-6}	9.2	9.3	11.5	11.8	11.8	11.6
Thermal Conductivity Btu/sq.ft/ft/hr—°F@ 68°F	22	20	69	67	61	71
Elec. Cond. %IACS@ 68°F Soft	7	7	27	26	24	28
Mod. of Elas. (Tension), psi.	16,500,000	15,000,000	14,000,000	15,000,000	14,000,000	14,000,000
FABRICATION PROPERTIES						
Machinability Rating**	60-70	30	80	30	30	40
Cold Working	P	E	F	F	P	F
Hot Working	E	E	E	E	E	E
Hot Working Range °F	1300 1600	1350 1550	1200 1500	1200 1500	1150 1300	1150 1450
SPECIFICATIONS						
A.S.T.M.	B124-42T Alloy 11	B124-42T Alloy 9	B124-42T Alloy 2	B124-42T Alloy 3	B124-42T Alloy 4	B124-42T Alloy 1
Federal	QQB666 Grade B	QQC-591a Grade A	QQB-611A Comp. A	QQB-636	QQB-721a Class A	
Navy	46B17 INT Gr. 3	46B-27	47B-2g	46B-6J	46B-15d	
Army						
AMS	4631					

E—Excellent G—Good P—Poor F—Fair

**Machinability Rating—Free cutting brass=100.



The great variety of non-ferrous forging alloys available makes possible the manufacture of forgings with an unusually wide range of physical and corrosion resistant properties.

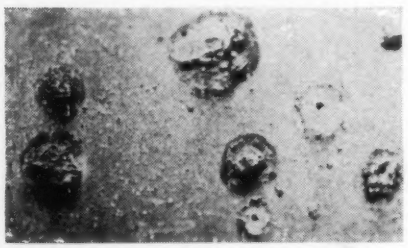
CAUSES OF CORROSION

This article is one of a series of discussions by C. L. Bulow, research chemist of the Bridgeport Brass Company.

Accelerated Corrosion—Hot Wall Effect

It is 20 years since Carl Benedicks carefully investigated a service failure encountered in steel boiler tubes. His work revealed that severe local corrosion or pitting can rapidly perforate heater tubes on the water side. The pitting takes place where bubbles of air separate from the water. He found that hot spots form on the heated tube surface at the points where the bubbles of gas cling to the metal.

Bubbles of gas repeatedly formed at the same point (usually at scratches or sharp indentations), thereby hindering the liquid from cooling the metal surface. It was also learned that the rate of perforation of a heater tube increased considerably with an increase in tube wall temperature.

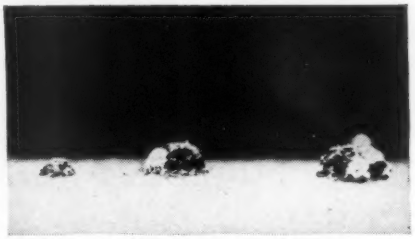


Nodules covering pits formed on the water side of a copper water heater tube. Mag. 8x.

This work suggested the following preventive measures:

1. The temperature should be no higher than necessary.
2. Continued uninterrupted heating should be avoided.
3. The production of new scratches on the metal surface might shift the point of bubble formation.
4. Air or gas should be removed from the liquid being heated.

Visual examination in the laboratory tests revealed that there is a marked tendency for the bubbles of gas to grow rapidly at first and then remain in contact with the metal tube for some time. In the laboratory tests, non-ferrous and ferrous tubes failed quite rapidly when exposed to 3% sodium chloride solutions. In service, such failures are occasionally encountered on the liquid or water side which may be either the inside or the outside of the tube. Water heaters and evaporators with steam



Side view of nodules covering pits formed on the water side of a copper heater tube. Mag. 8x.

or flame on one side of the tubes illustrate the most common equipment where pitting occurs because of the "hot wall effect".

In ferrous tubes, (18-8 stainless steel) deep circular pits formed on the under side of horizontal tubes, where the bubbles pressed against them. The final rolling of the gas bubbles up around the side of the tube produced a noticeable upward streaming of the rust; localized corrosion was virtually absent on the top side of the tube. The pitted areas were covered with small grayish colored deposits resembling fish scales and a thin film of red brown rust covered the remainder of the unattacked or slightly attacked surface.

The copper base alloys behaved similarly to the stainless steel except that nodules of black or greenish black corrosion products (essentially Cupric Oxide, CuO) formed over deep pits which were filled with bright red, crystalline cuprous oxide (Cu_2O). This localized corrosive action proceeds at rates from 0.025" per year or more.

Apparently, there are several important factors which are accelerating the corrosion at the point of bubble contact, namely the combined action of:

1. A local high temperature...
2. A high concentration of corrosive agents (base or salt), separating out where the bubble forms...
3. Quantity of dissolved gases.

In addition, the gas composition of the bubbles also probably plays a part. It should be noted that the reaction between the corrosive agent and the metal is a chemical one, yet the explanation given places the emphasis upon the physical aspect, which makes possible this rapid corrosive action.

NEW DEVELOPMENTS

This column lists items manufactured or developed by many different sources. None of these items has been tested or is endorsed by the Bridgeport Brass Company. We will gladly refer readers to the manufacturer or other sources for information.

A New Jack Welding Control is now available in 150 and 230 ampere sizes. It has a special tack welding circuit control panel designed for tack welding with constant potential supply. Round nichrome wire resistors are mounted on insulators and the housing has sheet metal sides with an expanded metal top to provide full circulation of air. Current values are controlled by contacts and are adjusted by turning fibre handles tight against copper bus bar to connect various resistors into circuit. Resistors are disconnected by turning handles in opposite direction and locking them in position. Current adjustment in both units is possible in 10-ampere steps. (501)

A Blind Fastener serving as nut-plate, rivet or both, is now being made of brass as well as aluminum. The tensile and shear strength of the brass alloy fastener is approximately 50% greater than that of equivalent size in aluminum. These devices are being employed for many industrial assemblies in addition to aircraft applications for which they were originally designed. (503)

A New Fire Extinguisher that is highly adaptable for use on trucks, automobiles, boats and planes is now available. It is light in weight and employs a vaporizing liquid that may be used effectively on electrical, oil and gasoline fires. The design assures immediate piston action even after long periods of disuse. Piston cannot stick to cylinder wall and a panic safety lock is operable by turning the handle in either direction. Brass drop forgings are used for cap, stuffing box, handle lock and handle seal, eliminating all interior soldered joints. It will not leak, even when subjected to vibration or rough handling. (504)

A New Welding Ground Clamp has been developed with each jaw connecting independently to the ground cable. The welding ground clamp assures proper ground connection with either one or both jaws carrying rated current. The unit weighs 1½ pounds, has a maximum jaw spread of 2½ inches and is rated at 300 amperes. The clamp has a processed steel frame with durable copper conductors and contacts. (505)

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SHEETS, ROLLS, STRIPS—*Brass, bronze, copper, Duronze,* for stamping, deep drawing, forming and spinning.

CONDENSER, HEAT EXCHANGER, SUGAR TUBES—For steam surface condensers, heat exchangers, oil refineries, and process industries.

PHONO-ELECTRIC* ALLOYS—High-strength bronze trolley, messenger wire and cable.

WELDING ROD—For repairing cast iron and steel, fabricating silicon bronze tanks.

LEDRITE* ROD—For making automatic screw machine products.

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BRASS, BRONZE, DURONZE WIRE—For cap and machine screws, wood screws, rivets, bolts, nuts.

DURONZE ALLOYS—High-strength silicon bronzes for corrosion-resistant connectors, marine hardware: *hot rolled sheets* for tanks, boilers, heaters, flues, ducts, flashings.

COPPER WATER TUBE.

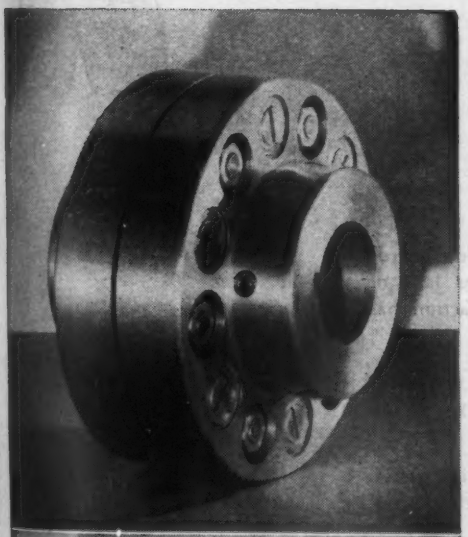
FABRICATING SERVICE DEPT.—Engineering staff.

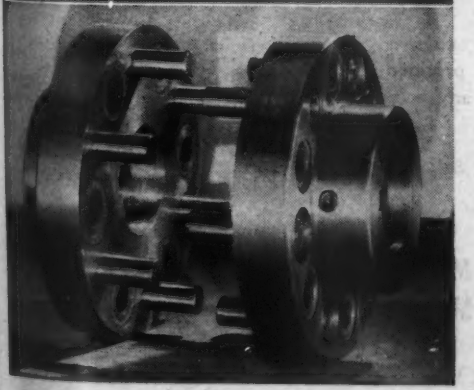
BRASS AND COPPER PIPE

Note: Bridgeport products are supplied in accordance with existing priority regulations.

*Trade name.

BRIDGEPORT ARMY E NAVY **BRASS**





Try and Do It!

Just try to hold a couple of pencils in perfect alignment without touching each other, and see what happens.

This 10-second test will quickly show you why a flexible coupling is mighty important to the life of direct-connected machines.

Ajax Flexible Couplings provide a positive but resilient connection between driving and driven shafts. They make it possible for each shaft to rotate around its own axis without creating vibration, chatter, strain on bearings, drag, power loss, reversal of torque and other detrimental features.

Ajax interlocking drive studs held by rubber-bushed, graphited bronze bearings assure maximum flexibility, quiet operation, and complete elimination of lubrication problems.

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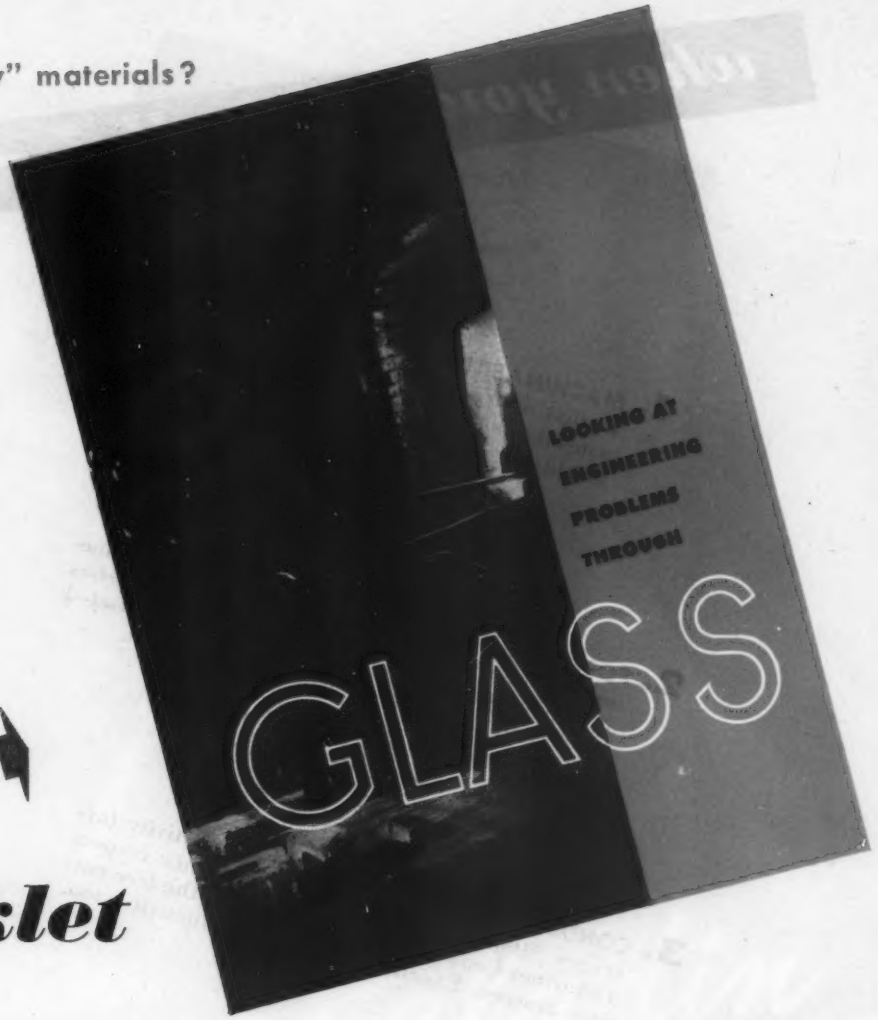
★ A Load off Your Shoulders onto Ours ★

Are you looking into "new" materials?



This booklet

may help you solve a problem!

If you want information on modern industrial glass, this booklet will be useful to you, and may suggest a means of improving your products or reducing your costs.

Glass is, of course, *not* a new material—in fact it is one of our oldest. However, recent advances in glass technology have endowed it with new and improved properties, thus enabling design engineers to use glass to considerable advantage in a wide variety of applications.

We will be glad to send you a copy of this imagination-stimulating publication. The material it contains is based upon extensive experience in the manufacture and application of glass products. Send for your copy now!

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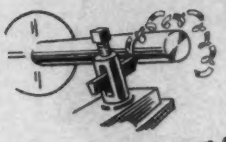

1. MACHINABILITY—With an ease of machining close to that of free-cutting brass, this new alloy eliminates the bottleneck of producing parts from tough machining copper.

2. FORGEABILITY—Hot forges readily—tellurium has no adverse effect upon the hot working properties of copper—an important advantage over leaded copper. May also be extensively cold worked.

3. CONDUCTIVITY—High electrical conductivity (averages 90% of pure copper's). In this respect Tellurium Copper far surpasses any of the free cutting brasses. Excellent thermal conductivity, too.

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CHASE TELLURIUM COPPER

Naturally, an alloy that combines all these features has found many uses in the aeronautical industry (for the manufacture of small contact pins or inserts in multiple contact assemblies)... in Electrical, Radio, Communications and similar applications, as well as in the welding and cutting torch tip field.

Full information on this unusual alloy, developed and patented by Chase Brass & Copper Co. is, of course, available on request.

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conquers hard-to-finish surfaces

THROUGH THE YEARS the superiority of Roxalin's plastic-base protective coatings has been demonstrated repeatedly by tests like this and proved under rigorous service in the field.

In this case, cadmium-plated steel has been half-primed with commercial primer, half with Roxalin's Paladin, followed by a wrinkle enamel top coat. Note how the Paladin anchored system clings to this hard-to-finish surface when gouged by the knife blade.

Paladin clings with equal tenacity to clean steel, stainless steel, black plate, tin, unanodized and anodized aluminum, copper, brass and glass.

Inside or outdoors, Paladin can take it. Salt spray, humidity and solvent resistance are inherent in this plastic-base coating. Its super flexibility permits blanking, forming or extruding *after* finishing.

This and other standard products are described in detail in "20 Years of Plastic Surfacing." Documented case histories plus exact specifications will give you ideas of how the right type of plastic-base finish can speed production, lower costs and help you design a better product. Write to Dept. 806 for your copy immediately as only a limited number of copies have been printed.

ROXALIN *Flexible* FINISHES
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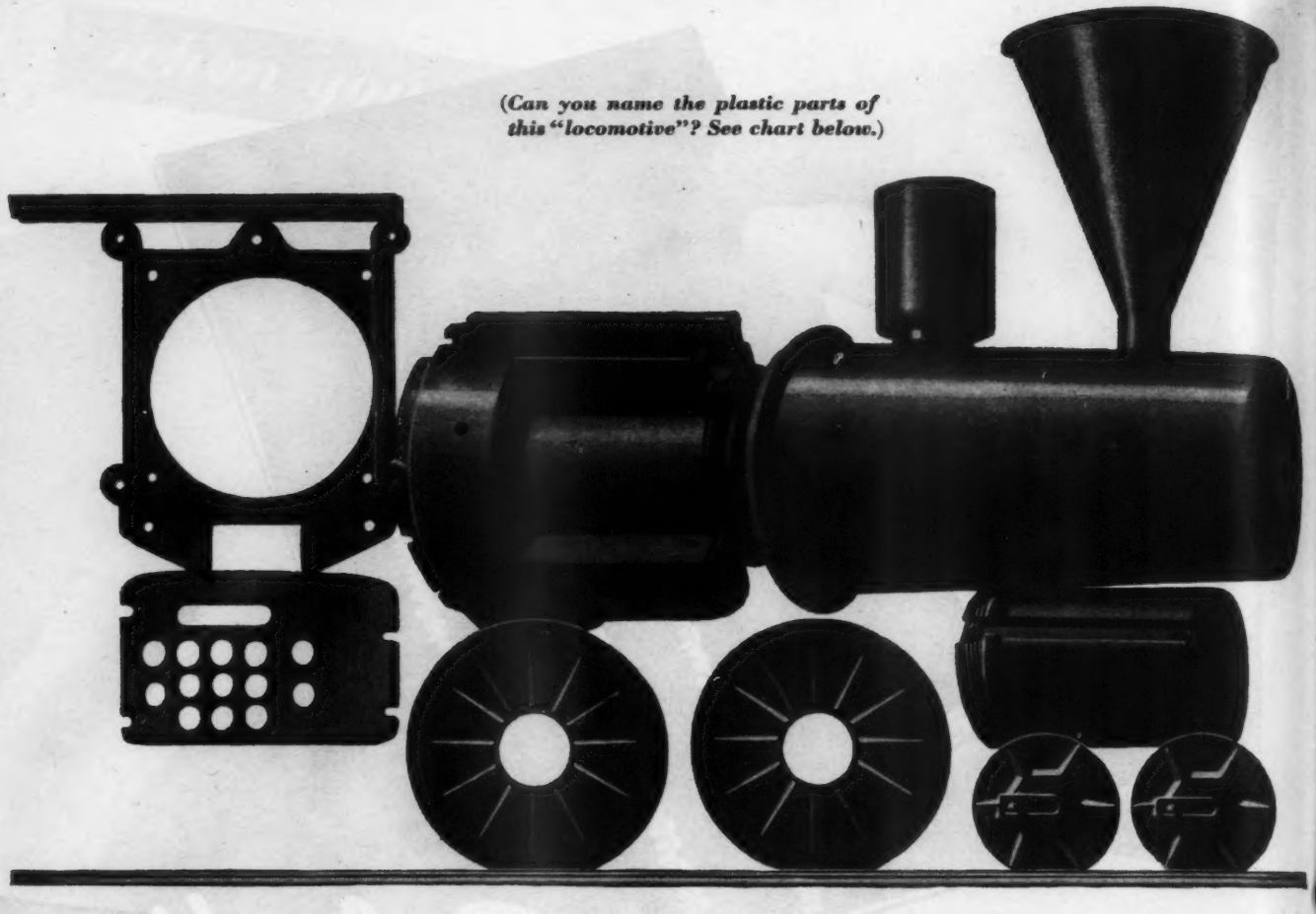
ELIZABETH • NEW JERSEY

PIONEERS IN PRODUCT FINISHES ENGINEERED FOR SPECIFIC PERFORMANCE

(Can you name the plastic parts of this "locomotive"? See chart below.)



How to put your product on the right track

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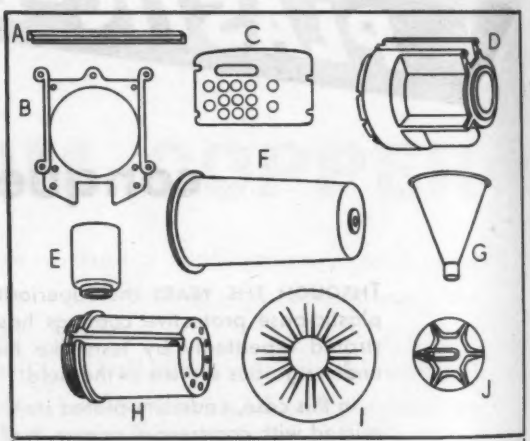
Our engineers, designers and research men work closely with the leading raw material manufacturers, and have immediate access to all latest developments.* Our long experience counts when it comes to giving your product the qualities it needs—whether beauty, durability, toughness, lightness or any others.

Our Plastics Division is equipped to produce by any one of the modern fabricating techniques—compression, injection, extrusion, lamination or sheet forming—assuring you of the best possible service at the lowest possible cost.

So, no matter what your product problem may be, come to Continental. You'll find an alert, progressive organization equipped to give sound, practical advice and assistance at all times!



(a) Molding—extruded; (b) Mount for fog horn assembly—compression; (c) Keyboard cover—compression; (d) Military device—compression; (e) Retainer—compression; (f) Sales ticket holder—compression; (g) Funnel—compression; (h) Electrical device part—compression; (i) Sheave—compression; (j) Distributor rotor—compression.

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Postwar Finishes

You will find this new bulletin on Berry Brothers' Production Finishes very helpful in connection with your postwar planning. It describes more than 50 Berry Brothers' Production Finishes, giving properties and where used.

We have been, and still are, heavily engaged in the production of wartime industrial and aviation finishing materials, but many improved new finishes, developed through wartime research, will be available for your postwar use.

We suggest that you include the selection of a suitable finish, early in your new-product planning, because the type of finish you use, and your finishing room equipment and methods are definitely a part of your finish selection.

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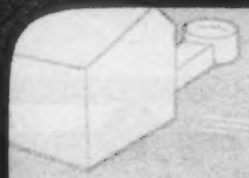

New

Nearly everyone in the mechanical industries knows about or uses Kipp Air Grinders. The Kipp announcement nearly fifteen years ago of the first hand grinder which turned 40,000 R.P.M. was a welcome surprise to tool makers. They always knew mile-a-minute surface speed was needed to remove metal instead of excessively rubbing down grinding wheels with slower speeds. The Kipp Air Grinder was the solution to the long standing grinding problem of getting into small places with small wheels.

The new Kipp Featherweight Grinder was made ready for post-war production. It can be sold now only because Aluminum and Magnesium have been more widely released. This post-war product, designed to meet all comers, can therefore be used in the continuing war jobs and for civilian jobs whenever they can be started.

Please include priority information in your wire orders.

MADISON-KIPP CORP.

206 Waubesa St., Madison 4, Wis. U.S.A.

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New

KIPP
Featherweight
AIR GRINDER

The Model [illegible] design, both inside and outside. [illegible] fewer parts and they are [illegible] magnesium and Aluminum [illegible] featherweight lightness. The [illegible] diameter is unusually large [illegible] and true operation [illegible] longer wheel life and better [illegible] as before, is governed [illegible] and there are selected ball [illegible] rear. The dA Featherweight is a [illegible] improvement over all models previously produced by Madison-Kipp, the originators of really high speed grinders.

The same low price, $29.75 in U.S.A., remains. It is a post-war design for which materials have been released early. The pre-announcement output was geared to expected demand. Deliveries will be made out of stock as long as possible.

by

MADISON-KIPP

MODEL JA

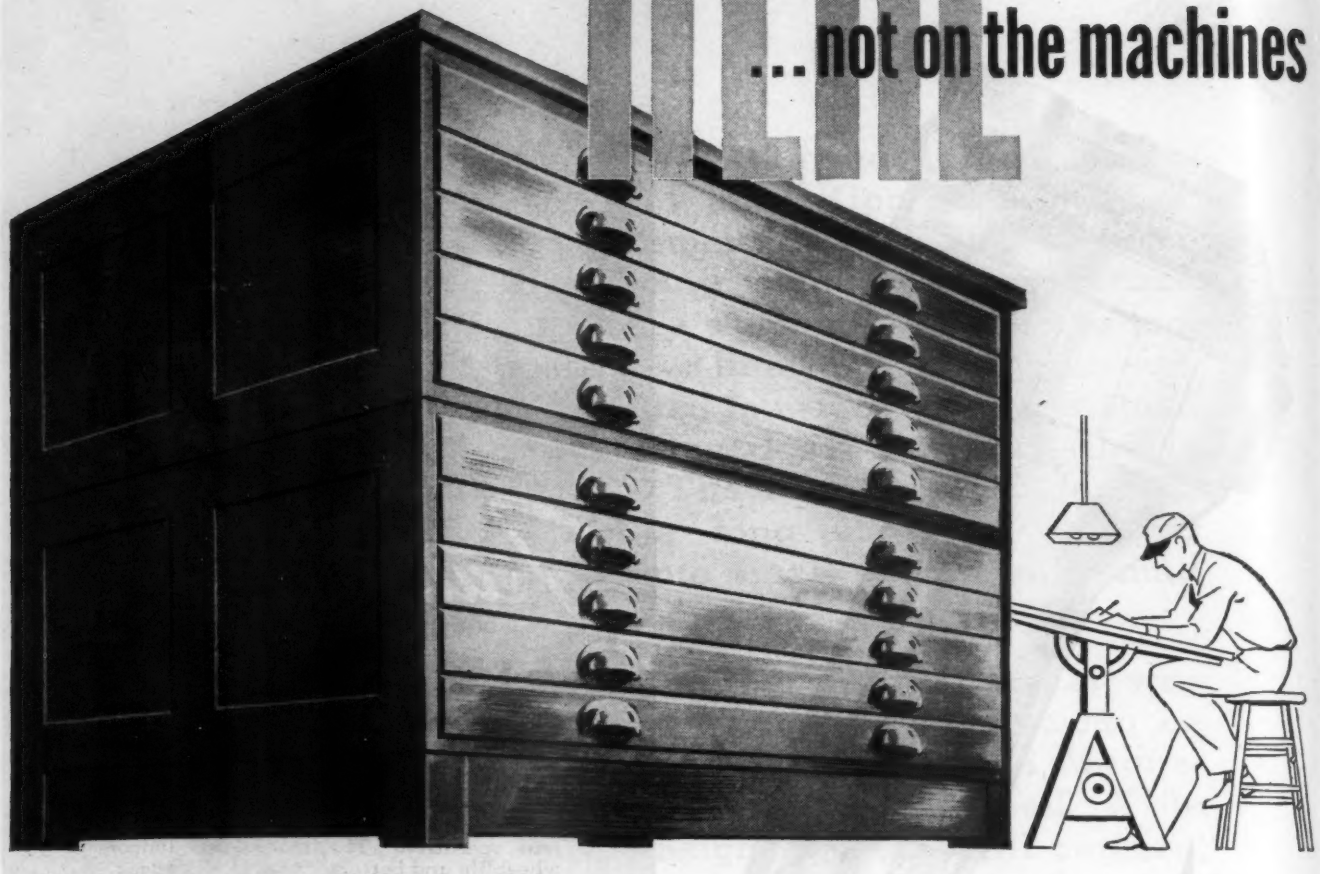
50,000 R.P.M.

$29.75 in U.S.A.

NOTE:—Higher speeds at higher prices are available if supporting engineering data are submitted. Higher speeds are not recommended unless properly supervised.

Weight 12 ounces; Length 6¾ inches; Chuck Size ⅛ inch. Wheel Guard Removed for Better Illustration

Your originals belong HERE ...not on the machines



PENCIL originals are precious, but even when they are new they often give unsatisfactory shop prints. When they are handled, they wear and blur. Prints made from them get cloudier still.

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IT'S A STANDARD PRODUCT

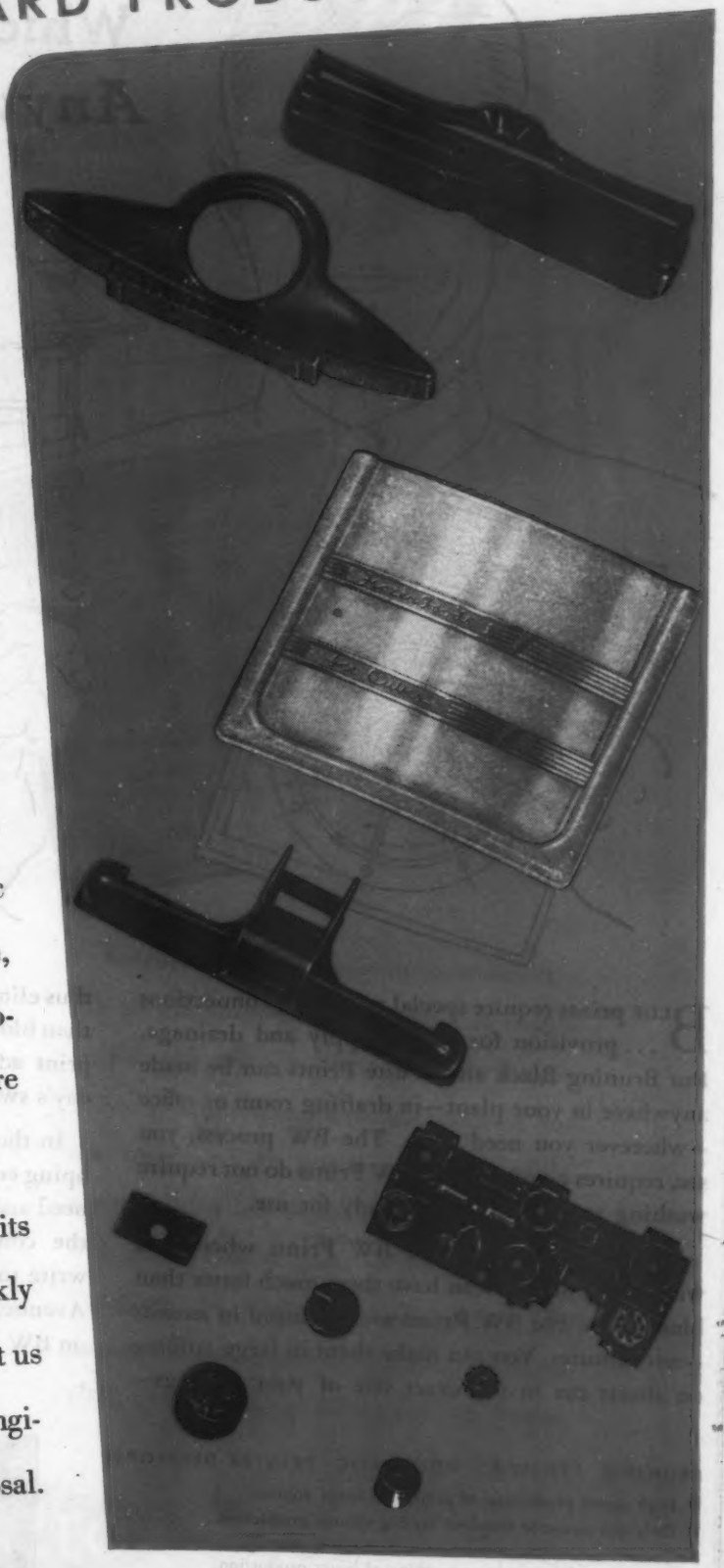
Plastic

MOLDING SERVICE

Through years of experience, the Standard Products Co. has acquired a wealth of knowledge in the art of molding plastics. Standard offers complete molding service.

Standard's molding equipment is capable of producing items of phenolic cellulose-acetate, butyrate, polystyrene, ethocel and other plastic and thermoplastic materials. These facilities assure perfection in the molding job.

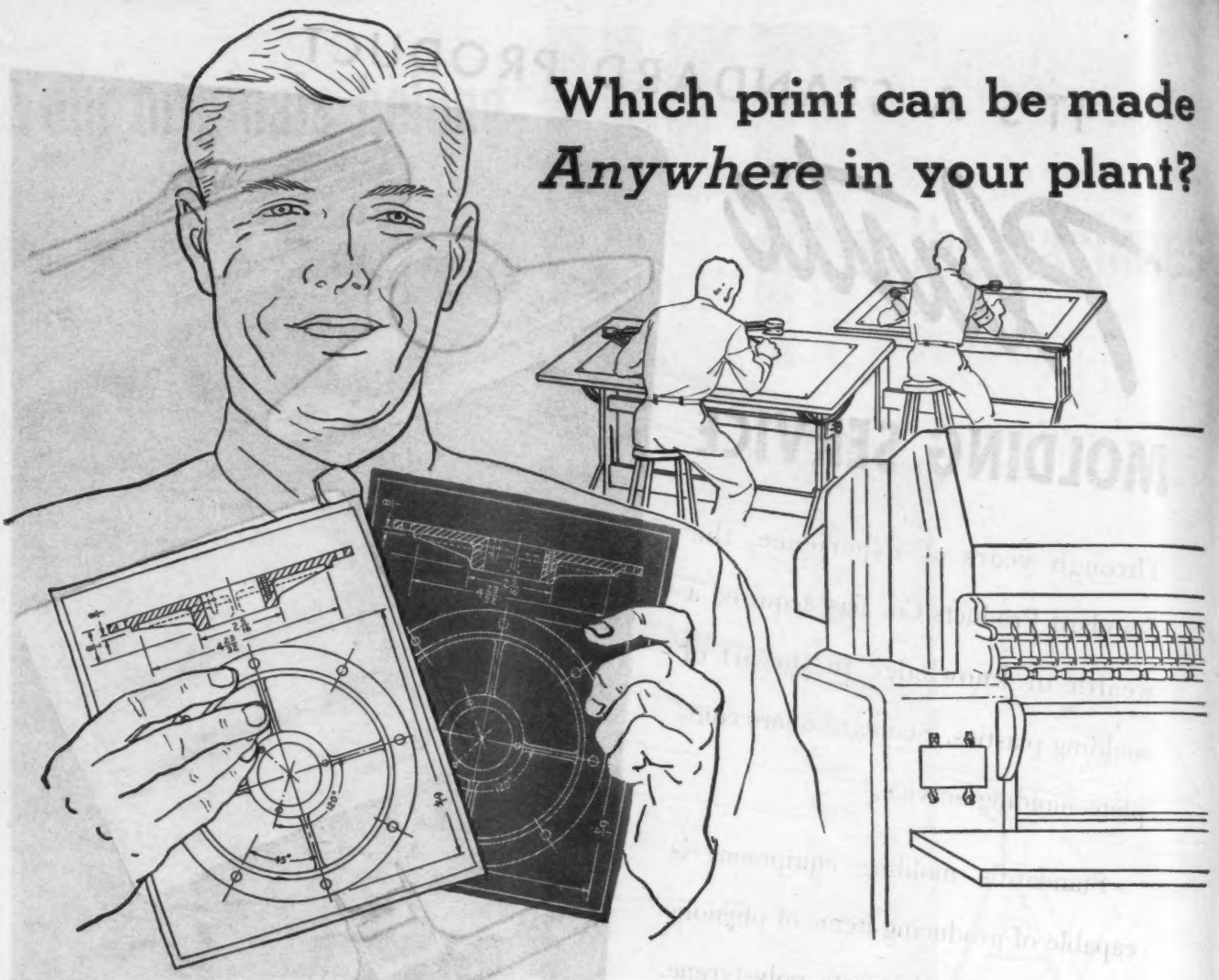
The Standard Products Co., with its great resources, can do your job quickly and effectively at moderate cost. Let us have the necessary data and our engineers will submit designs and proposal.



THE STANDARD PRODUCTS COMPANY

505 Boulevard Bldg. • General Offices and Research Laboratory Woodward Ave. at E. Grand Blvd. • Detroit 2, Mich.

Which print can be made *Anywhere* in your plant?



BLUE prints require special plumbing connections . . . provision for water supply and drainage. But Bruning Black and White Prints can be made anywhere in your plant—in drafting room or office—wherever you need them. The BW process, you see, requires no plumbing. BW Prints do not require washing and are delivered ready for use.

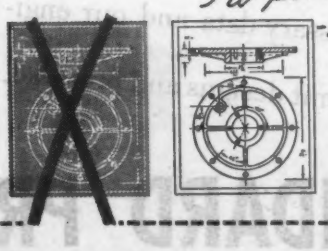
Not only can you make BW Prints where you want them, but you can have them much faster than blue prints. For BW Prints are produced in *seconds*—not minutes. You can make them in large volume on sheets cut to the exact size of your tracings—thus eliminating trimming and waste. Easier to read than blue prints, BW Prints bring you truly modern print advantages . . . help you keep pace with the day's swift production.

In the complete line of BW printing and developing equipment, there is a machine for every print need and capacity. Find out why print users all over the country are switching to BW Prints—and write to Charles Bruning Co., Inc., 4700 Montrose Avenue, Chicago 41, Illinois, for new free booklet on BW Prints.

It's positively right -in Black and White

BRUNING "75-159-B" VOLUMATIC PRINTER-DEVELOPER

- ★ High speed production of prints—in large volume.
- ★ Only one operator required for big volume production.
- ★ Current consumption less than half of the operating amperage of an arc lamp machine of lower production.



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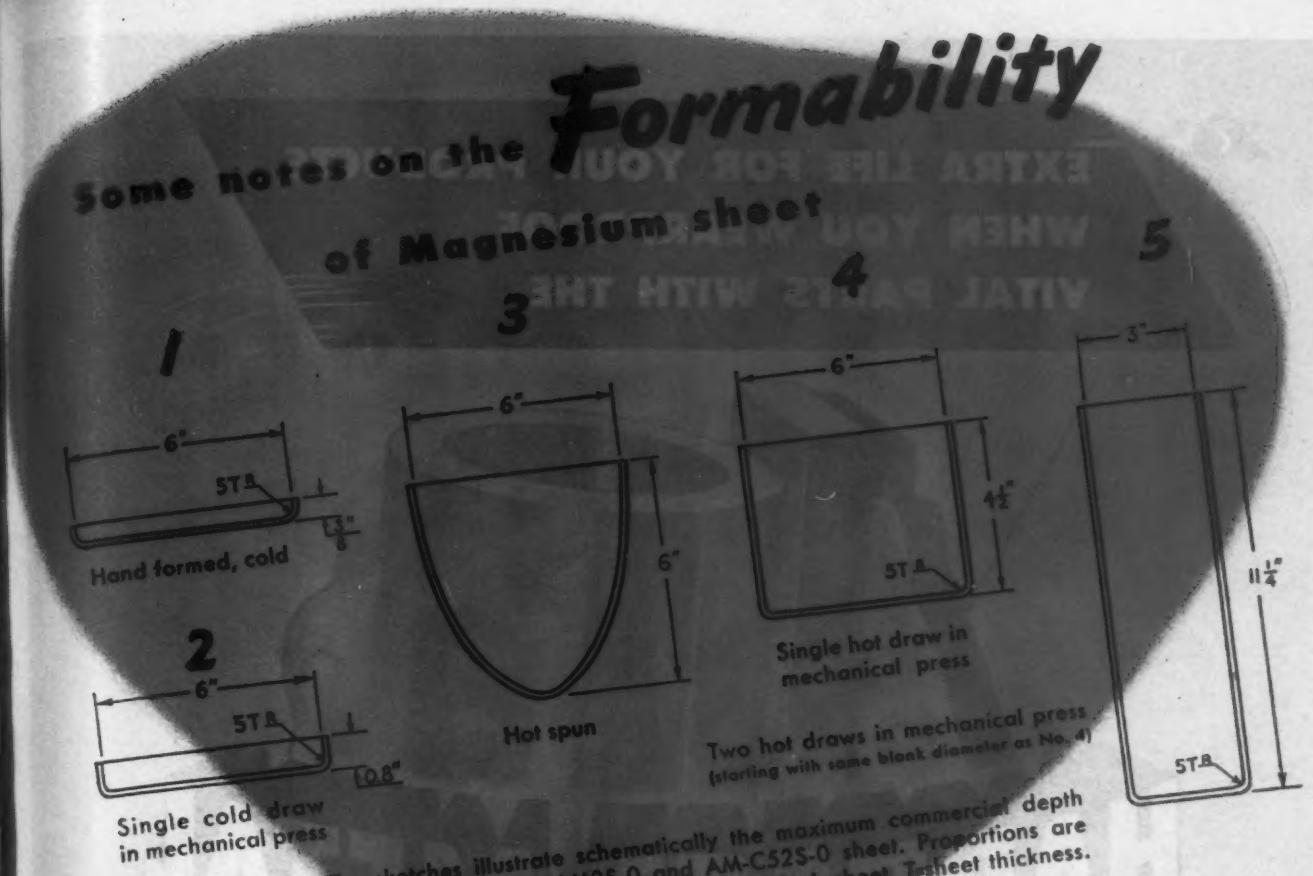
Some notes on the Formability of Magnesium sheet



"How deep will it draw?". . ."Can it be spun?". . ."Must the metal be heated to produce this shape?" Such questions, and many more, are answered in American Magnesium's book, "Designing with Magnesium".

Magnesium has been an extremely active war worker. There is the wealth of knowledge gained there to guide you, plus American Magnesium's more than twenty years of working with magnesium alloys.

Achieving the ultimate in lightness is a job which magnesium does well. It weighs only one-fourth as much as the heavy metals. It has a high strength-weight ratio. If you are interested in employing this weight-saving ability of magnesium, our engineers will gladly assist you. Write Aluminum Company of America, Sales Agent for American Magnesium Corporation Products, 1702 Gulf Building, Pittsburgh 19, Penna.

MAGNESIUM MAZLO PRODUCTS

AMERICAN MAGNESIUM CORPORATION

SUBSIDIARY OF ALUMINUM COMPANY OF AMERICA

EXTRA LIFE FOR YOUR PRODUCTS
WHEN YOU WEARPROOF
VITAL PARTS WITH THE

HARDEST METAL MADE BY MAN

Cemented carbide, the hardest metal made by man, has extreme resistance to abrasion, and many forms of corrosion. It retains original size and shape and continues to function efficiently for periods often as long as 100 times that of other metals.

Carboloy Cemented Carbide may be used in the form of an insert brazed into your part at the point of wear—or it may be employed as an integral part made entirely of Carboloy metal. Available in practically any shape and in sizes having a top surface area as large as 100 square inches.

Already widely employed to improve the performance of many diversified products such as machine tools, textile machinery, spray guns, bread slicing equipment, fishing rods, etc., Carboloy Cemented Carbide may be the answer to *your* wear problem. Write for booklet WR-101.

. . . to stop excessive wear on vital parts of your products

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TRADE MARK

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CARBOLOY COMPANY, INC.
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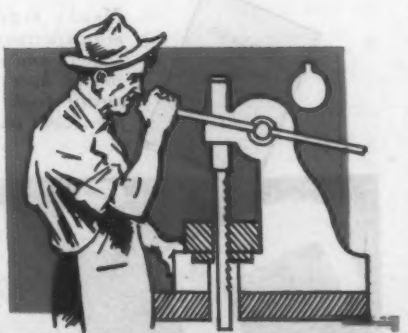
WHAT HAS THIS TO DO WITH BROACHING?

TODAY, countless ships plow fog-shrouded seas, hurrying vital supplies to our fighting men. Swarms of 'planes hum a dirge over the axis homeland. Arid lands are made fertile and productive. Mighty rivers are harnessed to provide power for distant war industries. Propellers — pumps —turbines . . . modern necessities and conveniences without number . . . stem from the unknown genius in whose brain was conceived the principle of the screw. The mists of years obscure his name, yet from Galileo to Gutenberg to Millennium, developments of this basic idea have, and will continue to, profoundly influence our civilization.

IN the same manner that so many complex machines, essential to Man's progress, developed from the fundamental principle of the screw, so too, has broaching developed from crude tools capable of limited uses, to mighty machines capable of performing metal removing operations with speed and precision, in an almost endless variety of shapes and sizes . . . and making them quicker, cheaper and BETTER!



The first broaching machines were invariably arbor presses, and were generally used to cut keyways in pulleys and gears.

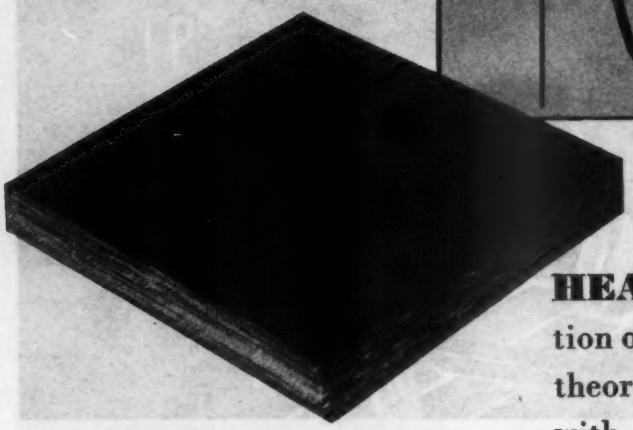
ARMY E NAVY

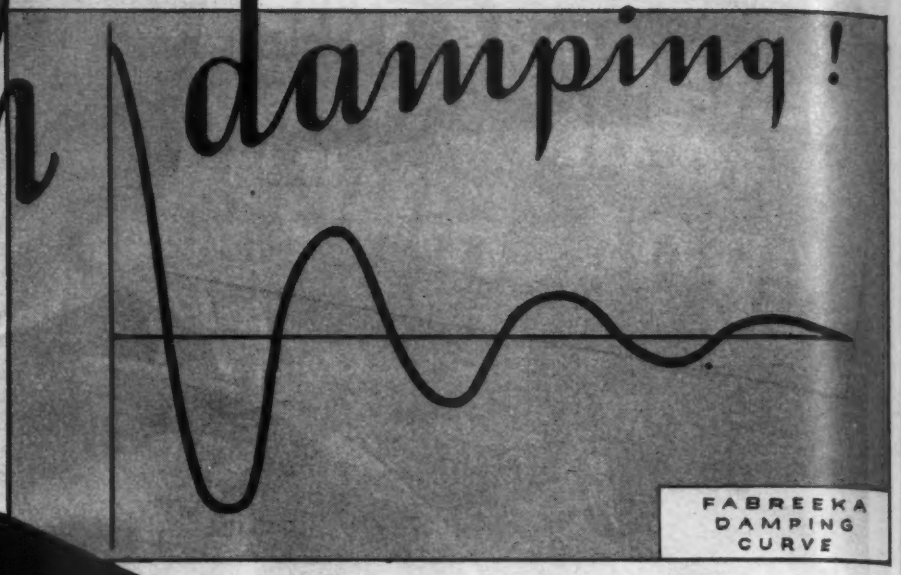
The LAPOINTE Machine Tool Company

HUDSON, MASSACHUSETTS, U. S. A.

THE WORLD'S OLDEST AND LARGEST MANUFACTURERS OF BROACHES AND BROACHING MACHINES

high damping!





... WHEN DESIGNING HEAVY MACHINERY the effective isolation of vibration is frequently a compromise between theory and practice. That is why FABREEKA—with its limited resiliency and high damping—is often much more practical than more resilient materials with a low damping factor. FABREEKA has an unusual success record as a *practical* material to absorb shock and high frequency vibration... Send for the latest edition of our famous Red Book *"Fabreeka for Impact Shock and Vibration"*

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5 Principal Characteristics of **FABREEKA**

- ★ Limited Resiliency
- ★ High Damping
- ★ Minimum Permanent Set
- ★ Great Strength
- ★ Long Life

Heavy machinery manufacturers, designers and engineers should have this authentic book in their files. Sent on request.

FABREEKA

PADS, WASHERS, BUSHINGS, MOULDED UNITS

BELTING FOR POWER TRANSMISSION AND CONVEYING

This Book May Help You Pick
THE FINISH FOR YOUR POSTWAR PRODUCTS

Polymerin Finish Dries Faster, Stays Beautiful Longer!

"The Facts on Polymerin" describes the two-way competitive advantages you can gain by finishing your postwar products with durable, speed-bake Polymerin.*

Polymerin is an organic baking enamel with unusual properties of durability and resistance . . . properties which may be varied to meet the individual requirements of such products as refrigerators, stoves, washing machines, bicycles, lamps, fluorescent reflectors, artificial tile, kitchen and under-sink cabinets, gasoline pumps, venetian blinds, vending machines and other appliances.

Polymerin stays beautiful longer! Impartial tests have shown that Polymerin is nine times harder to chip than ordinary enamels. And Polymerin—the original speed-bake finish—offers production advantages, too. For Polymerin's faster drying results in savings which can help you keep your finishing costs low!

Regular Polymerin is not available now, *but it is time now to discover how* Polymerin *can help you make and sell a better product after the war!* Use the coupon below to get your free copy of "The Facts on Polymerin", a 32-page booklet which presents clearly and factually the sales and production advantages of a Polymerin finish. This information-packed booklet is yours for the asking . . . send for a copy today!

*Reg. U. S. Pat. Off.

POLYMERIN

The Original Speed-bake Finish

A PRODUCT OF AULT & WIBORG

DIVISION OF INTERCHEMICAL CORPORATION

A-5

Ault & Wiborg Division of Interchemical Corporation, Empire State Bldg., New York 1, N.Y.

Please send, without obligation, a free copy of "The Facts on Polymerin"—the book that shows how a Polymerin finish can increase sales and reduce finishing costs.

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*Company*_____

*Address*_____

DESIGN FOR FUNCTION...AND GLASS WILL GIVE YOU

Beauty as a Dividend

Designers of tomorrow's storefronts are using glass, in many forms, colors and finishes, to attract customers inside, to make the whole store a mammoth showcase, and to provide an exterior that will successfully resist weathering. Beauty is a natural result.

You may be figuring on using glass in your postwar products because of its great resistance to weathering, to acids or to abrasion. For its transparency. For the flatness and smoothness of its surface.

One thing is sure. You'll have no trouble making your products attractive if you use glass—for glass is inherently a beautiful material. Glass keeps its perfect finish . . . year after year . . . indoors or out.

Want your product colorful or colorless? Transparent, translucent or opaque? With a satiny smooth finish, or with a ribbed, pebbled or hammered effect? Flat or curved?

Even though you're interested in glass chiefly as a durable structural material, why not take advantage of the *extra* beauty that comes with glass?

There are many characteristics of glass that make it a sound material for tomorrow's products. We'd like to discuss these properties of glass with you. Address your inquiry to Libbey·Owens·Ford Glass Company, 24124 Nicholas Bldg., Toledo 3, Ohio.

Destructible? **Wood — Metal — Plastics — Glass. No material is indestructible. However, barring unseen conditions, no material will fail on a job in which it has been properly specified and engineered. When our application engineers say "Yes", you can be sure about glass.**

LIBBEY·OWENS·FORD
a Great Name in **GLASS**

WHY ISOLATE YOUR *HEAT TREATING?*

WILLYS-OVERLAND MOTORS, Inc., reports this time-saving idea in the manufacture of flywheel ring gear assemblies for the famous Jeep:

A compact, cool, clean TOCCO machine—used for shrink-fitting—is spotted between two milling machines which perform related operations. Conventional heating practice . . . cumbersome, hot and dirty . . . would have required isolation of the shrink-fitting operation and a costly production detour. The handy TOCCO set-up allows this efficient procedure:

The man shown in the picture machines one side of cast iron flywheel in machine at left . . . places it and ring gear in TOCCO work fixture . . . presses TOCCO start button.

The TOCCO machine automatically heats ring gear to 400°F. in 12 seconds, expanding its 12″ diameter .025″ . . . lowers ring gear and presses it on flywheel . . . quenches ring gear, cooling and shrink-fitting it to flywheel.

A second man removes the assembly from TOCCO and machines other side of flywheel in machine at right.

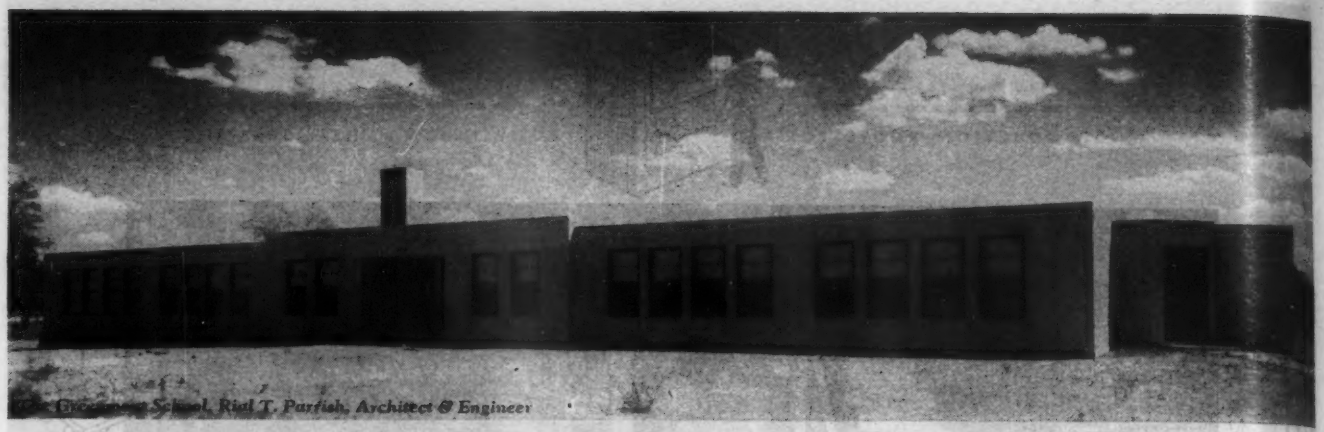
Since TOCCO almost operates itself, only two men are required for this three-machine set-up.

Find out how TOCCO can solve many of your present and postwar production problems. The book, "Results with TOCCO," will be sent free on request.

THE OHIO CRANKSHAFT COMPANY • CLEVELAND 1, OHIO

TOCCO

INDUCTION
HARDENING . . BRAZING
ANNEALING . . HEATING

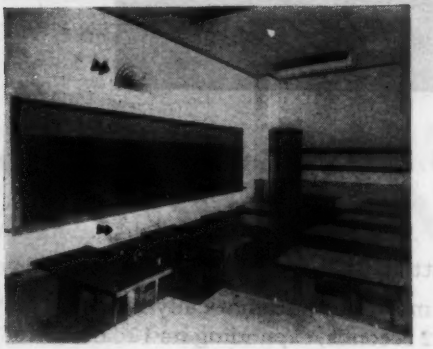


Greenmont School, Rial T. Parrish, Architect & Engineer

A Man with Imagination has done something to the Little Red School...

Over in Greenmont, near Dayton, Ohio, they wanted to build a new public school—a better school—with all those "common sense" features that "you always wish you had after the building is finished and you're having trouble."

And so, they hired a man with imagination to plan the work. This is the result—simplicity—utility—beauty. No doubt, he remembered the shortcomings of his own little red school days, hence, something new in school buildings. This one is all on one level—affording better protection against fires and possible catastrophes. He remembered—and so, there are three separate sections with separate entrances for the kindergarteners, the intermediates, and the older children. He remembered, too, about the lighting and made adequate provision.



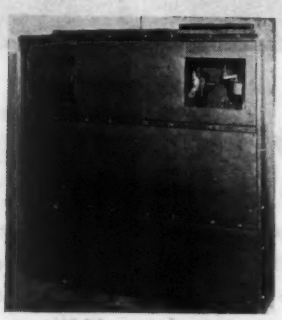
Interior of Greenmont School features good lighting—efficient arrangement. Heating and Ventilating Units installed in furred space inside the walls separating corridor and classroom eliminate accidents—and provide easy access on corridor side by the removal of an Ls panel.

Even paper wads—chewing gum

There are no hot stoves in The Greenmont School, no sizzling radiators to cause accidents, no open grillwork to become a fire-hazardous receptacle for paper wads, litter, and chewing gum. A special heating and ventilating unit was selected which provided space conservation—draft-free air distribution—fuel economy—and improved appearance. A further provision is made for air purifiers which will eliminate all air-borne germs. In fact, the features of the unit were such that it actually brought about a lowering of insurance rates.

The heating and ventilating unit, a product of still other men with imagination—the manufacturing division of the Russell R. Gannon Co., Cincinnati—was designed for its specific purpose.

An interesting feature of the unit is its use of Lindsay Structure as a combination of supporting structure and housing for the equipment. Lightweight, requiring minimum space, Ls supports the entire operating mechanism of the unit, completely enclosing it in a business-like cabinet that fits into the wall. Removable panels make all parts easily accessible for any necessary maintenance operations.



Self-contained unit produced by Russell R. Gannon Company, Manufacturing Division. Lindsay Structure supports, as well as houses, all equipment.

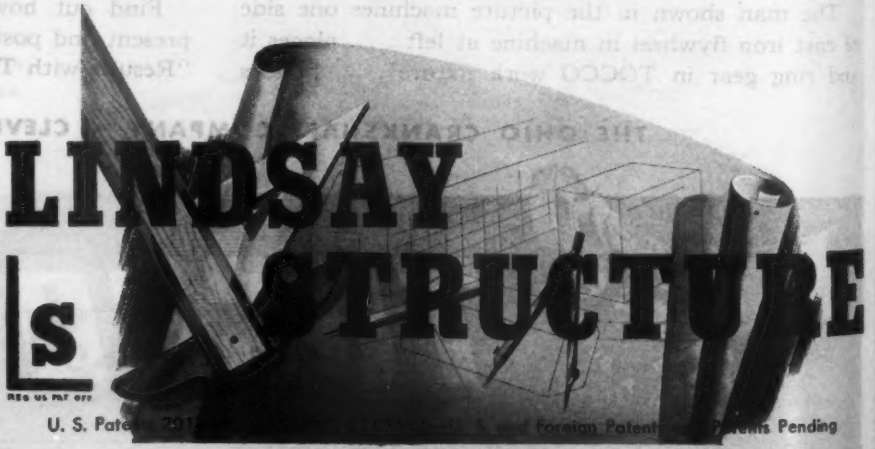
Further advantages reported by Mr. Gannon are gained by the "pre-formed" nature of Lindsay Structure, which lends itself perfectly to line assembly operation. Die-cut, die-formed to exact dimensions, Ls is quickly and easily put together on the line with ordinary tools, with no welding, no riveting, no waste.

According to Mr. Gannon, Lindsay Structure lends itself ideally to line production of Gannon Heating and Ventilating Units.

Here is another proof of the versatility of Lindsay Structure—another of the thousands of good products made better—stronger—lighter because men with imagination "found Lindsay Structure."

Your Problems

Ls engineers will be happy to collaborate on design for your new equipment. It will pay you to write for information today. **Lindsay and Lindsay, 222-B W. Adams Street, Chicago 6, Illinois; or 60 East 42nd Street, New York 17, New York; Lindsay Structure (Canada) Ltd., Dominion Square Bldg., Montreal.**



Periscope Pickup!

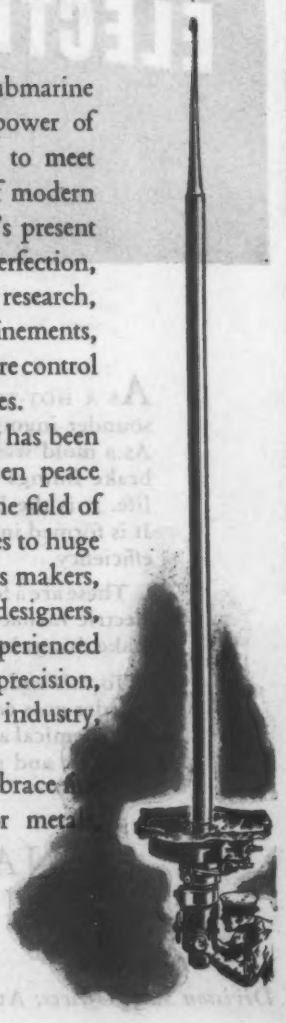
From his bridge, the submarine commander watched the sky battle, saw a plane hit by flak, the pilot take to the silk, and splash in the sea. As the sub set out for the rescue, Japanese batteries blazed, forced it to submerge. With only the periscope protruding, the underwater craft moved close to the fallen flyer. Twice the pilot swam away, suspecting the underwater boat was a Jap. But finally he clutched the 'scope, was towed safely out of range!

RESOURCEFULNESS qualifies the silent service for emergency. U. S. sub commanders and crew are undaunted by the unusual, have poked into Tokyo harbor, taken nurses off Corregidor, landed observers on hostile coasts, served as the subway for the underground movements, scouted all the seas, dared danger in many spectacular exploits—sunk or damaged over 900 Jap ships since Pearl Harbor.

Kollmorgen, leading producer of submarine periscopes, has demonstrated high power of achievement in developing products to meet the rapidly changing requirements of modern naval warfare. Much of the periscope's present efficiency, mechanical and optical perfection, has come from Kollmorgen's intensive research, which continually contributes refinements, greater precision to navigational aids, fire control instruments, many fine optical devices.

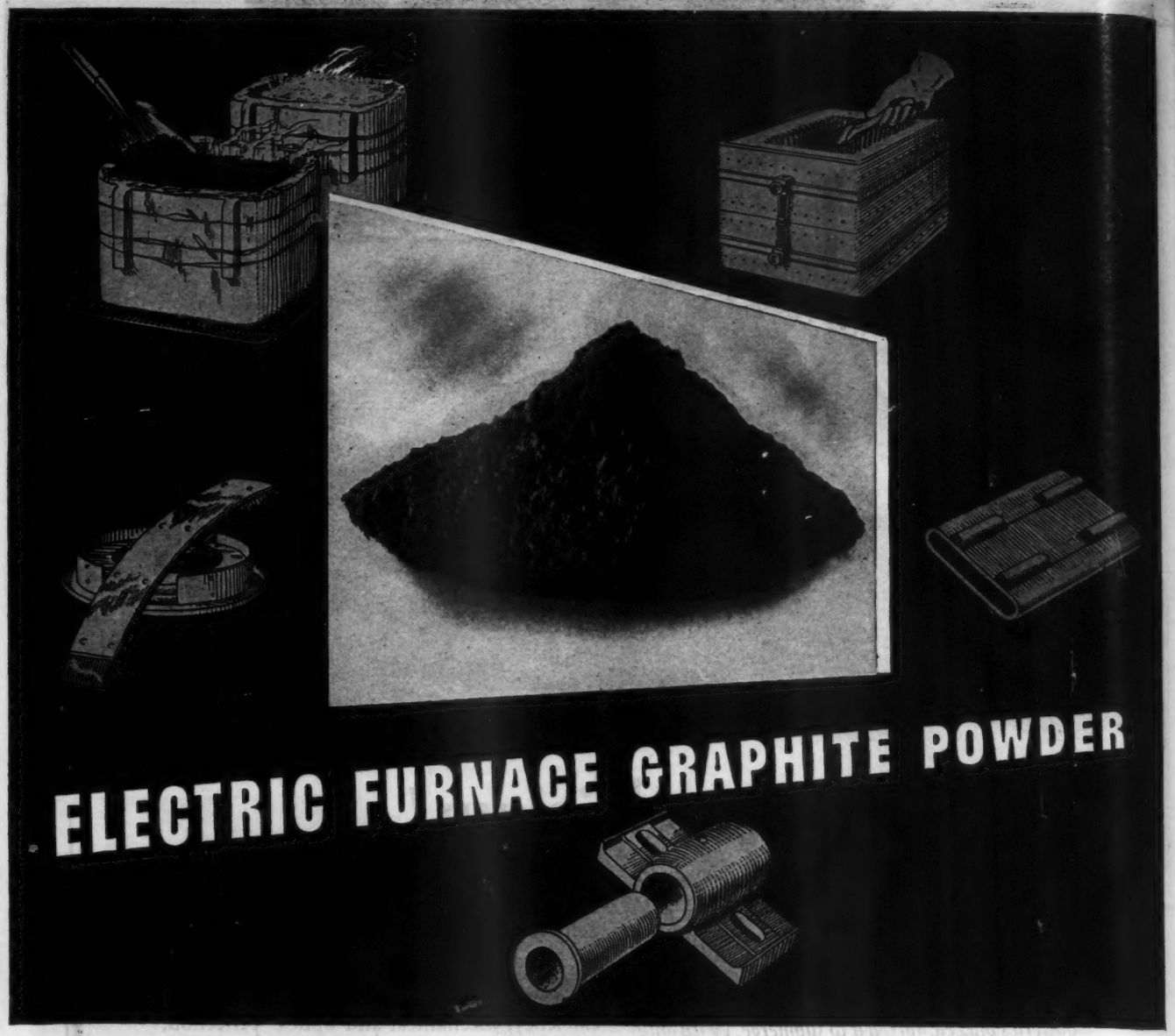
During the war, the U. S. Navy has been Kollmorgen's main customer. When peace comes, production will again range the field of precision optics, from pin point lenses to huge objectives. Then the Kollmorgen lens makers, accustomed to minutest tolerances, designers, machinists, and engineers long experienced in optics and instruments of highest precision, will welcome new assignments from industry, science and education.

If your postwar plans or ideas embrace precision craftmanship in glass or metal, consult with us now!



KOLLMORGEN OPTICAL CORPORATION

2 Franklin Avenue, Brooklyn 11, N. Y.



MAKES THEM BETTER!

As a hot-topping compound, it produces sounder ingots by reducing the size of the pipe. As a mold wash, it prevents stickers. It provides brake linings with essential qualities for longer life. It is the lubricant of many oilless bearings. It is formed into electronic tube elements of high efficiency.

These are a few of the many jobs that "National" electric furnace graphite powder performs . . . to make things better!

To this end, an increasing amount of graphite powder goes each year to the iron and steel, foundry, chemical and process, petroleum, rubber, mechanical, and many other industries. Besides the applications illustrated, graphite powder is used in powder metallurgy, clutch facings, fabric belting, greases, wire drawing, rubber compounds, powder glazing, crucibles, batteries, boilers, ink and paint pigments, pencils, crayons. The list grows steadily.

"National" electric furnace graphite powder comes in a number of grades, each classified on the basis of purity, electrical resistance, and fineness . . . all held within accurately controlled limits.

Ask us how electric furnace graphite powder may help serve you . . . or serve you further.

KEEP YOUR EYE ON THE INFANTRY
. . . THE DOUGHBOY DOES IT!

The word "National" is a registered trade-mark of National Carbon Company, Inc.

NATIONAL CARBON COMPANY, INC.

Unit of Union Carbide and Carbon Corporation

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CONTROLLED QUALITY

one of 8 big reasons why you can depend on Ampco Metal Parts

Quality control is one of the main features that set Ampco apart from ordinary sources of bronze — that assure you of an engineered alloy unvarying in its properties today, next month, or a year from now. This uniformity is important when performance of your equipment depends on material that *always* meets predetermined specifications. • Ampco's laboratory control — a long-established feature of Ampco service — is carried out by the largest corps of technicians in the bronze alloy field.

Ampco also offers you the production "know-how" to *produce* to a standard. • Utilize the exceptional properties of Ampco Metal in your post-war products — it pays! Send us your prints for helpful suggestions. Ask for bulletins.

Only from Ampco can you get *all* of these services and benefits:

1. Distinctive properties of resistance to wear, impact, fatigue, corrosion.
2. A series of engineered alloys—with physical properties to fit your application.
3. Quality control to hold these properties within narrow limits.
4. Diversified production facilities — coordinating in one place all the commonly used metalworking processes.
5. Engineering and production "know-how" to give you a practical manufacturing program.
6. A nation-wide organization of field engineers to assist you.
7. A record of proved performance in hundreds of leading makes of equipment.
8. A national reputation that makes Ampco Metal parts a sales asset.

Specialists in engineering, production, finishing of copper-base alloy parts

AMPCO Metal
The Metal without an Equal

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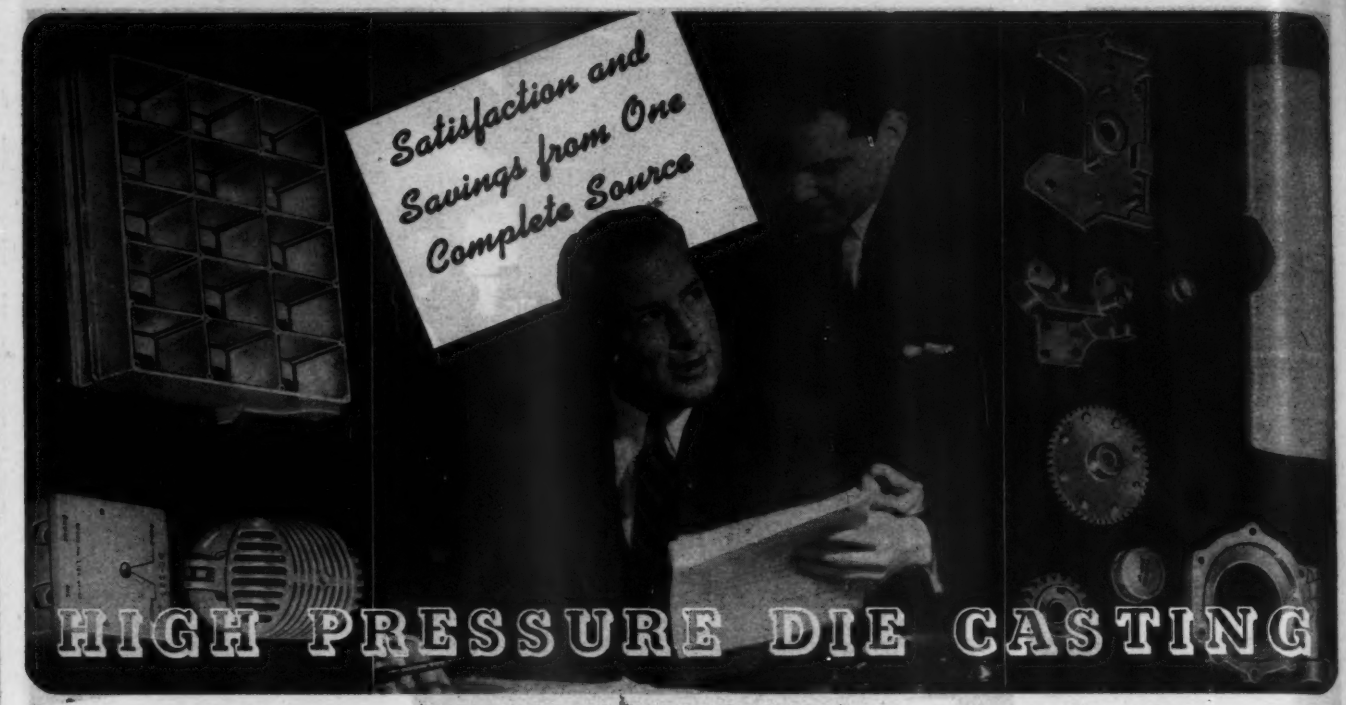
PE-12



From Start to Finish

the materials cast into your products are subject to complete control over both chemical and physical properties. Uniformity and inner-quality are assured through our Spectographic, Radiographic and physical testing equipment. Precise and efficient methods that served the Automotive, Aviation and Home Appliance Industries in Peace-time play a valuable part in wartime manufacture. Remember—our specialty is high-pressure die castings in the metal or metals which your products require.

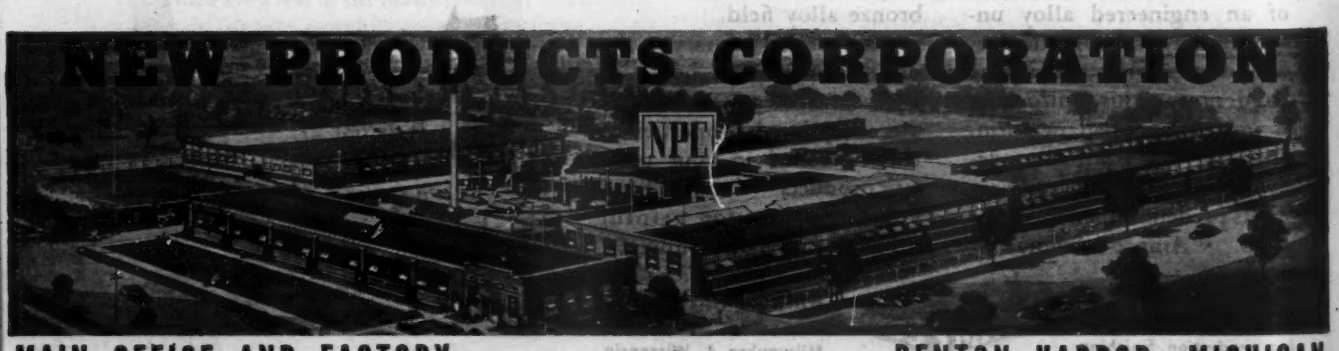
★

ALUMINUM ★ MAGNESIUM ★ ZINC

Plan now for those highly competitive peace days, when consumer again has A-1 priority. Ask New Products to work out your problems—complete, if you wish, from blueprint to finished product—in

HIGH PRESSURE DIE CASTINGS

★



MAIN OFFICE AND FACTORY • BENTON HARBOR, MICHIGAN

Inserts of WEAR-RESISTANT

KENNAMETAL . . .

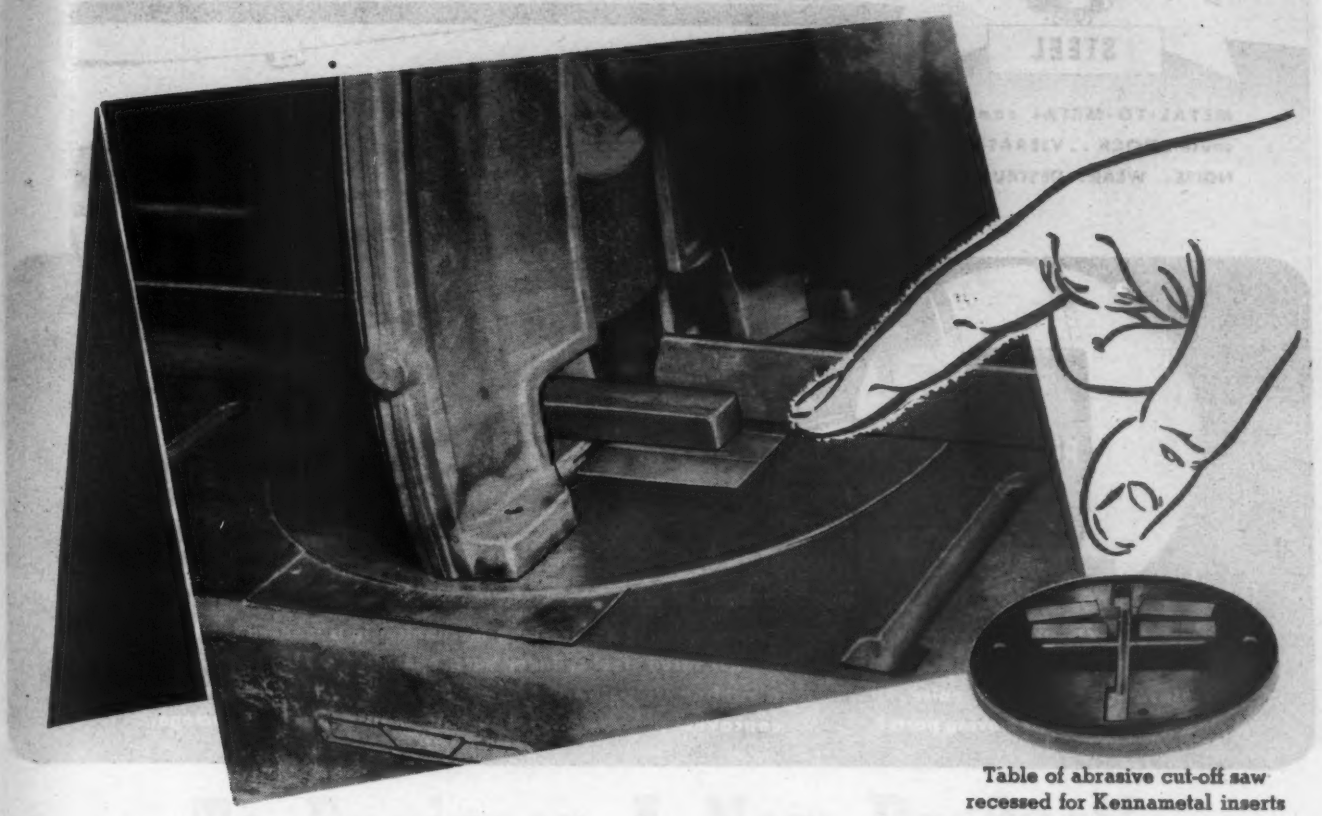


Table of abrasive cut-off saw recessed for Kennametal inserts

CAN OFTEN SALVAGE EXPENSIVE PARTS

. . . AND PROVIDE A NEW SURFACE THAT OUTWEARS THE ORIGINAL UP TO 100 TIMES!

The effective life of many types of machines can be lengthened, and costly shutdowns eliminated, by using Kennametal at strategic points. The illustrations of the abrasive cut-off saw clearly show how standard Kennametal blanks, made primarily for cutting tools, can be used as wear-resistance units. The original surfaces of the saw rest wore quickly, allowing the steel to wobble, causing uneven cut-off. Kennametal inserts, recessed into the table, make a smooth, hard surface of unsurpassed durability.

• The superiority of Kennametal for "specialty" applications comes from a combination of unique properties—amazing hardness (78 Rockwell C), low coefficient of friction, high modulus of elasticity (2 to 3 times that of steel), dimensional stability, and resistance to corrosion and erosion.

Kennametal is available in standard shapes (flat blanks, discs, balls), or it can be accurately molded into special shapes, limited only by reasonable proportions. You can use it profitably in your products, and production machinery. Tell us your wear problem. We will suggest how it may be solved with Kennametal.

SHOCK!
STEEL
STEEL
METAL-TO-METAL contacts cause SHOCK . . VIBRATION . . NOISE . . WEAR . . DESTRUCTION!
RUBBER
RUBBER
RUBBER-TO-RUBBER contacts ABSORB shock . . . MINIMIZE vibration . . . MUFFLE noise . . . PROLONG LIFE of moving parts!
Cut-away view of threshing mechanism in a modern combine. Rubber faced steel cylinder bars, operating in connection with a rubber stripping plate, and two stationary block rubber concaves, protect hard and soft shell crops from damage.

SHOCK is the foe of machinery. SHOCK and resultant VIBRATION caused by metal-to-metal contacts of moving parts are fast being eliminated by modern processes of rubber-to-metal adhesion.

A "striking example" of metal-to-metal *versus* rubber-to-rubber contacts is the development of the modern combine or "all-crop harvester."

ORCO engineers, working closely with farm machinery engineers, applied modern rubber adhesion processes to eliminate metal-to-metal contacts in threshing mechanisms.

The "end result" was elimination of SHOCK which in old style harvesters limited the machines to hard shell crops and often caused damage to both crops and machines.

Rubber-to-rubber contacts now widen the scope of the modern combine to include soft shell as well as hard shell crops. Machines last longer. Crops are protected against crushing. Operators are relieved of fatigue caused by excessive noise and vibration.

When YOU encounter problems involving SHOCK and VIBRATION in moving parts of machinery, ORCO engineers are prepared to co-operate. Ask for ORCO-OPERATION!

"ORCO-OPERATION"

THE OHIO RUBBER COMPANY · WILLOUGHBY, OHIO

BRANCHES: DETROIT · NEW YORK · CHICAGO · INDIANAPOLIS · WASHINGTON · CLEVELAND

Not So Simple...

...To Engineer A New Product!

This little self-locking nut plate is typical of Solar's challenging spirit which, fifteen years ago, brushed aside tradition to give the world the first really safe method of venting dangerous airplane gases—the Solar stainless steel exhaust manifold.

Two years ago there was a desperate need for self-locking nut plates for military plane production which would sustain high temperatures. Solar met the emergency with SOL-A-NUT... a stainless steel nut plate developed with Solar initiative on different principles of design and construction. SOL-A-NUT is simplicity itself—*now that it is finished.* But back of it are months of hard work and original thinking—of research and design—of material tests—trials in use—re-design and further tests.

It is not a simple matter to engineer new products, particularly those made of stainless steel and used where high temperatures prevail, or hot gases, acids and corrosion are encountered. Design engineers are invited to consult Solar in their problems. Address "Management"

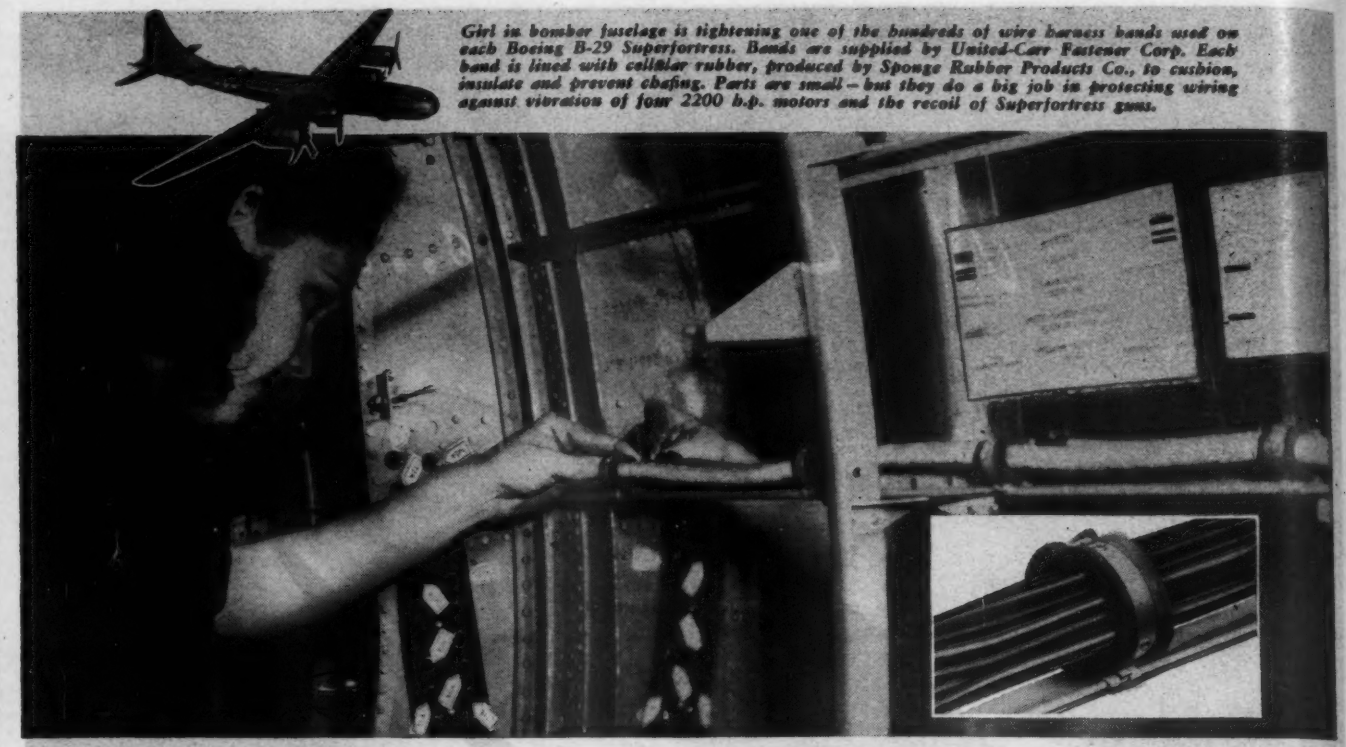
ARMY E NAVY ARMY E NAVY

SOLAR

STAINLESS STEEL PRODUCTS

SOLAR

SOLAR AIRCRAFT COMPANY SAN DIEGO 12, CALIF. DES MOINES 5, IA.



Girl in bomber fuselage is tightening one of the hundreds of wire harness bands used on each Boeing B-29 Superfortress. Bands are supplied by United-Carr Fastener Corp. Each band is lined with cellular rubber, produced by Sponge Rubber Products Co., to cushion, insulate and prevent chafing. Parts are small – but they do a big job in protecting wiring against vibration of four 2200 h.p. motors and the recoil of Superfortress guns.

THE RUBBER COLLAR THAT TOOK THE 'RUB' OUT OF WIRE HARNESS

. . . A lesson in post-war progress from a Boeing Superfortress

The tiny strips of cellular rubber that cushion the hangers for wires in the B-29 Superfortress cost just a few pennies. But what a man-size job they do! They soak up vibration . . . prevent chafing . . . keep wires in condition to "keep 'em flying"!

Wherever there is a danger of vibration – in an automobile, an airplane, a railroad train, a machine tool, a home appliance – *any* motor-driven piece of equipment – similar applications of cellular rubber can lengthen the life of equipment; help assure trouble-free operation.

Two Basic Types Available

Our organization, with 21 years' experience compounding sponge rubber (Spongex*) also produces another basic type of *cellular rubber* – Cell-tite*. In Spongex, the most familiar type of this material, the cells inter-connect. In Cell-tite the cells are individual, separate, filled with inert gases.

Consult us *now* if you need any variety of cellular rubber. We are able and ready to help you solve any problem of sealing, cushioning, vibration dampening, sound deadening, insulating, and have ample production facilities to meet your present and post-war needs.

* Trade Mark Registered

Available NOW for Industrial Production

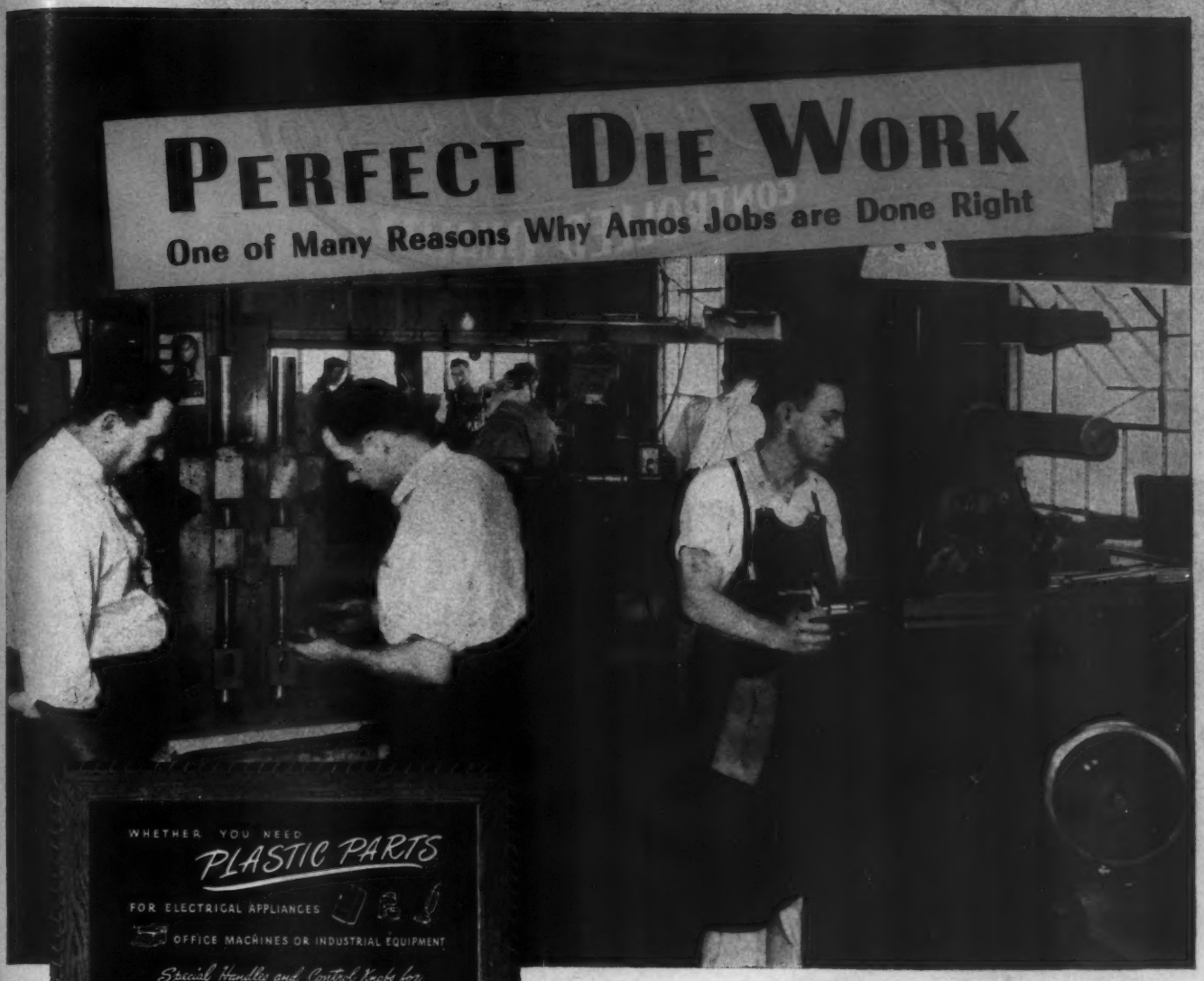
We compound cellular rubber to your specifications – have developed methods of controlling resiliency, cell structure, tensile strength, and resistance to heat, cold, moisture, oils, acids, corrosive vapors, and abrasion. If sheet material does not solve your problem of cushioning, sealing, sound deadening, insulating, or vibration dampening, we can supply you with tubing, cord, slabs, strips, or molded parts. Describe your requirements; our technical staff will tell you frankly whether or not cellular rubber will do your job.

Sponge Rubber Products Co.

123 Derby Place, Shelton, Conn. • Plants in Derby and Shelton, Conn.

Sales Offices: NEW YORK • CHICAGO • WASHINGTON • DETROIT

World's Largest Manufacturer of Cellular Rubber Products



WHETHER YOU NEED
PLASTIC PARTS
FOR ELECTRICAL APPLIANCES
OFFICE MACHINES OR INDUSTRIAL EQUIPMENT
Special Handles and Control Knobs for
TOOLS RADIOS AUTOS PLANES
CASES FOR CLOCKS CAMERAS JEWELRY
BATHROOM FIXTURES MEDICAL ACCESSORIES
Or Anything Else that's a Practical Plastic Application
You Get the Job Done Right by

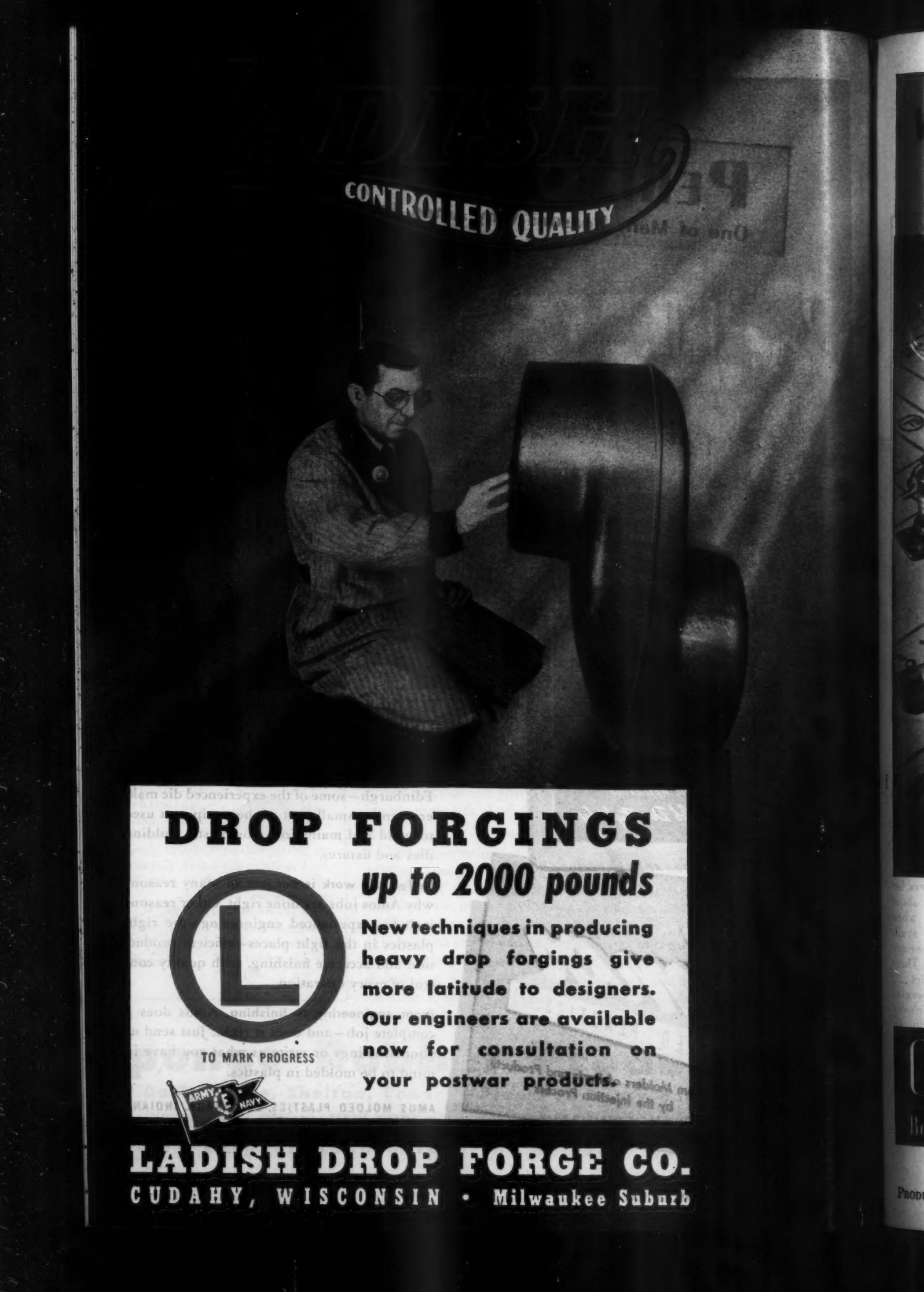
Amos
MOLDED PLASTICS...
Custom Molders of Parts and Products by the Injection Process

To do plastic molding jobs right, one of the many requirements is perfect die work. Above you see one section of the Amos Die Shop in Edinburgh—some of the experienced die makers—and a small part of the equipment used to build and maintain Amos plastic molding dies and fixtures.

Perfect die work is but one of many reasons why Amos jobs are done right. Other reasons include—experienced engineering—the right plastics in the right places—efficient production and accurate finishing, with quality control of every operation.

From engineering to finishing, Amos does a complete job—and does it right. Just send us your drawings or write us what you have in mind to be molded in plastics.

AMOS MOLDED PLASTICS, EDINBURGH, INDIANA
Division of Amos-Thompson Corporation



DROP FORGINGS

up to 2000 pounds

New techniques in producing heavy drop forgings give more latitude to designers. Our engineers are available now for consultation on your postwar products.

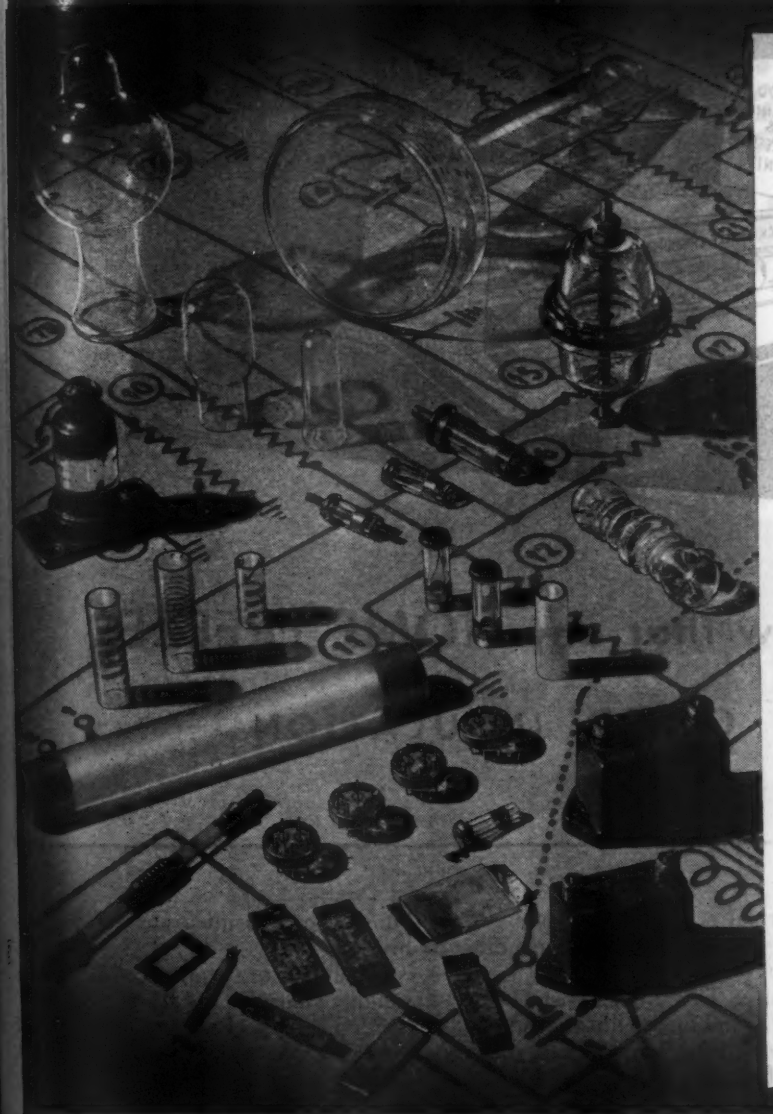
TO MARK PROGRESS

ARMY E NAVY

LADISH DROP FORGE CO.

CUDAHY, WISCONSIN • Milwaukee Suburb

WHAT WILL YOU NEED TO PRODUCE BETTER POST-WAR PRODUCTS?



CORNING GLASS GIVES YOU

Special Electrical Qualities
Thermal Endurance
Hermetic Sealing
Mechanical Strength
Corrosion Resistance
Precision
Permanence
Metallizing
Dimensional Stability

High dielectric strength — high resistivity—low power factor—wide range of dielectric constants—low losses at all frequencies.

Permanent hermetic seals against gas, oil and water readily made between glass and metal or glass and glass.

Commercial fabrication to the fine tolerances of precision metal working.

Corning's metallizing process produces metal areas of fixed and exact specification, permanently bonded to glass.

AS YOU plan post-war electronic products, give a thought to versatile glass. We really mean glasses, for Corning has, at its fingertips, 25,000 different glass formulae from which to select those especially suited to your electronic applications. Let us show what glass can do for you. We may already have a solution — or Corning Research can find the answer for you. Address Electronic Sales Dept., I-12, Bulb and Tubing Division. Corning Glass Works, Corning, New York.

CORNING *means* Research in Glass

Electronic Glassware

T.M.REG. CORNING U.S. PAT. OFF. T.M.REG. PYREX U.S. PAT. OFF.

"PYREX" and "CORNING" are registered trade-marks of Corning Glass Works

. . . but they all know that any HOME FREEZER MUST HAVE *GOOD* INSULATION

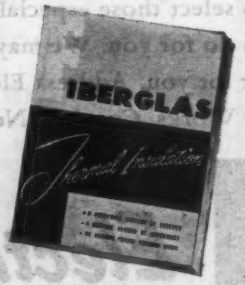
To hold the low temperatures required, and to keep operating costs at a minimum, home freezers must be insulated with a material having very definite characteristics and properties.

Of course, *low thermal conductivity* is of prime importance. But, still other qualities are also needed if the insulation is to do a *thorough* job and give lasting satisfaction to the user.

In Fiberglas* PF (Pre-Formed) Insulation, manufacturers found, years ago, a material that qualified on every count. Made of long, fine, resilient glass fibers treated with a binding agent, then compressed and "cured" to form insulating sheets of various thicknesses, densities and degrees of flexibility, Fiberglas PF Insulation offers many advantages.

In thermal efficiency, it has a conductivity of .25 to .30 (depending upon the density) at 70° F. mean temperature. This high resistance to heat flow, combined with almost negligible heat capacity, permits close control of temperatures.

Fiberglas, being *inorganic*, is highly moisture-resistant, picking up less than 1% by weight under high humidity conditions, and dries out without harm. It is odorless and does not pick up odors in service. It provides no sustenance for vermin. It will not corrode, nor is it corrosive to aluminum or steel in the presence of moisture. And Fiberglas has mechanical strength—doesn't settle, "dust" or disintegrate under vibration.



Easily cut to specifications, light in weight, Fiberglas fits readily into production line techniques. And manufacturers who use Fiberglas also find its light weight contributes substantial savings in freight.

If you produced home freezers before the war, or are thinking about entering this promising field when materials again are available, write for your free copy of the new "Fiberglas Thermal Insulation" booklet . . . *Owens-Corning Fiberglas Corporation, 1850 Nicholas Bldg., Toledo 1, Ohio. In Canada, Fiberglas Canada Ltd., Oshawa, Ontario.*

ARMY E NAVY

FIBERGLAS THERMAL INSULATION

*T. M. Reg. U. S. Pat. Off.

Announcing WEIRTON

HIGH CARBON STRIP

COLD ROLLED SPRING STEEL

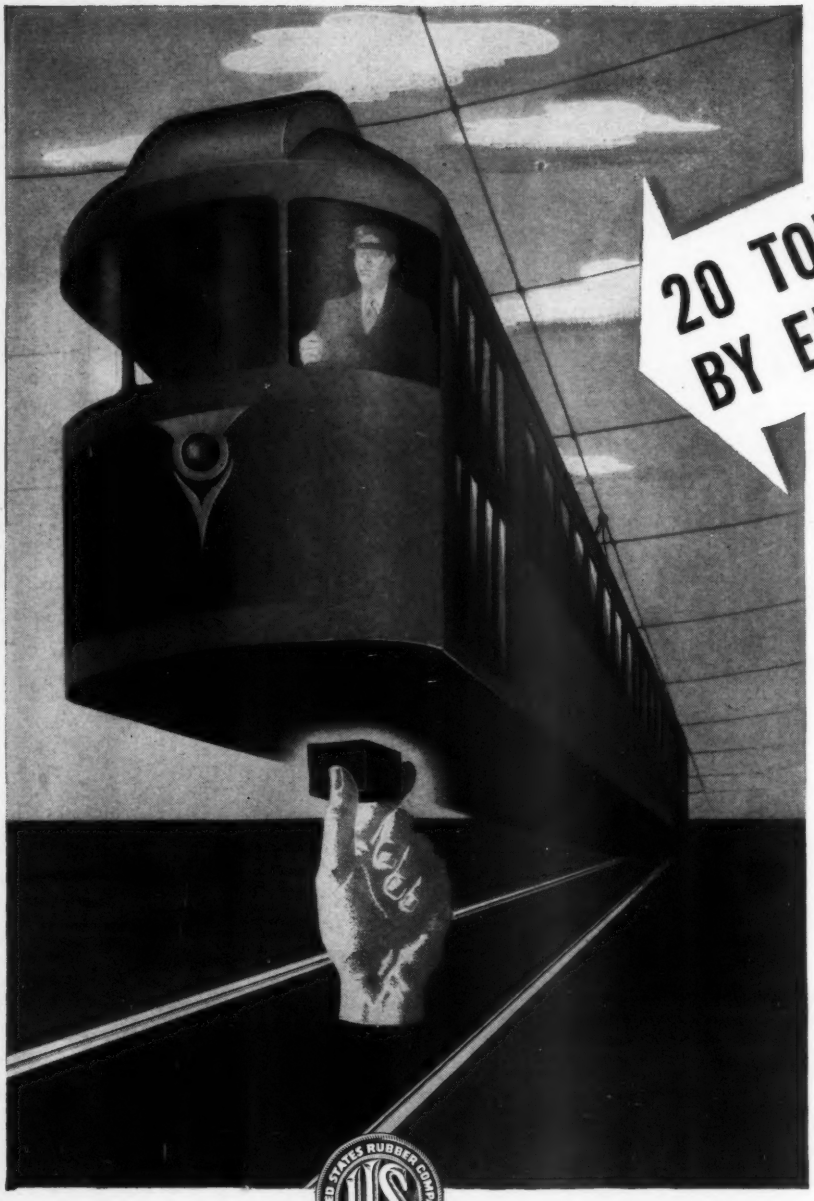
THE STRIP OF PRECISION STANDARDS

WRITE FOR A TEST SAMPLE

WEIRTON STEEL CO.

WEIRTON STEEL COMPANY

WEIRTON, WEST VIRGINIA *Sales Offices in Principal Cities*



20 TONS SUPPORTED BY ENGINEERED RUBBER

Only eight pieces of scientifically compounded rubber support 40,000 pounds!

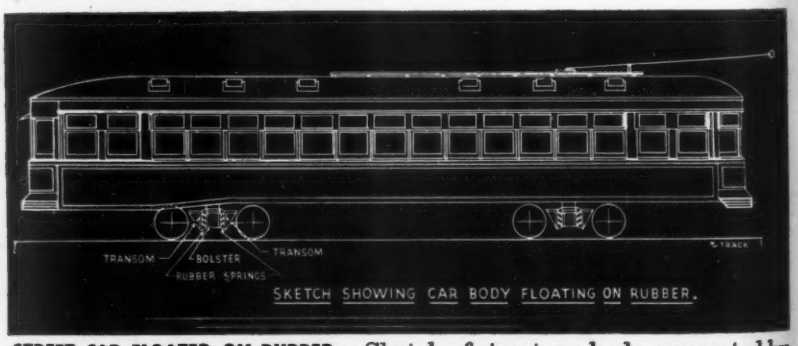
These rubber mountings were designed by United States Rubber Company to replace the leaf springs of trucks on street cars, and smooth out the ride. There is no sliding friction on such rubber springs... therefore no maintenance. Stress in all structural members above the springs is also reduced; much weight is saved through the relatively small size of the mountings.

Performance like this is responsible for the increased use of engineered rubber mountings not only on vehicles but also on a wide range of heavy industrial machines —drop hammers, lathes, blowers, and many others.

Such rubber-bonded-to-metal parts—an integral part of the structural design—cushion destructive vibration, reduce noise both inside and out and cut maintenance costs without sacrificing safety.

SERVING THROUGH SCIENCE

AFTER SIX YEARS OF SERVICE — Unretouched photograph of one of the rubber sandwiches which replaced leaf springs six years ago on a street car operating in a large Eastern city. When examined recently all were still in excellent condition.



SKETCH SHOWING CAR BODY FLOATING ON RUBBER.

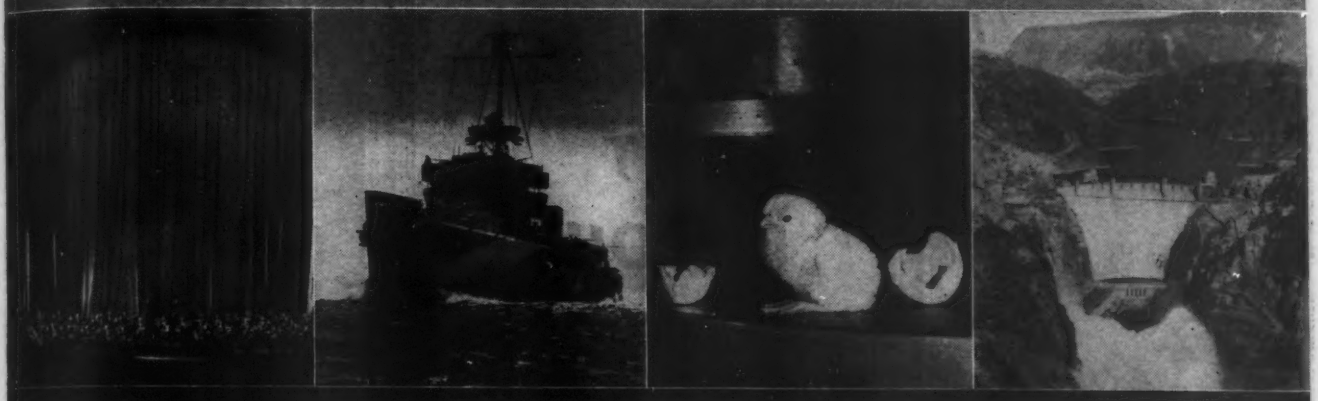
STREET CAR FLOATED ON RUBBER — Sketch of street car body supported by U. S. engineered rubber mountings. Note that these mountings are placed on each side of the bolster, and at both ends. The introduction of rubber as a structural part of heavy vehicles has done much to minimize noise, vibration, and shock not only on street cars but on railway cars, trucks and busses.

Listen to the Philharmonic-Symphony program over the CBS network Sunday afternoon, 3:00 to 4:30 E.W.T. Carl Van Doren and a guest star present an interlude of historical significance.

UNITED STATES RUBBER COMPANY

1230 Sixth Avenue • Rockefeller Center • New York 20, N. Y. • *In Canada:* Dominion Rubber Co., Ltd.

Would you believe it?



BALDWIN supplied the hydraulic elevators that raise and lower the stage of Radio City Music Hall.

BALDWIN diesel engines are used for main propulsion units on minesweepers and for auxiliary power on many other vessels.

BALDWIN testing machine of 3,000,000 pounds capacity can be controlled so as to break the shell of a hatching egg without harming the chick.

BALDWIN hydraulic turbines, 115,000 horsepower capacity, driving huge electric power generators, are installed at Boulder Dam.

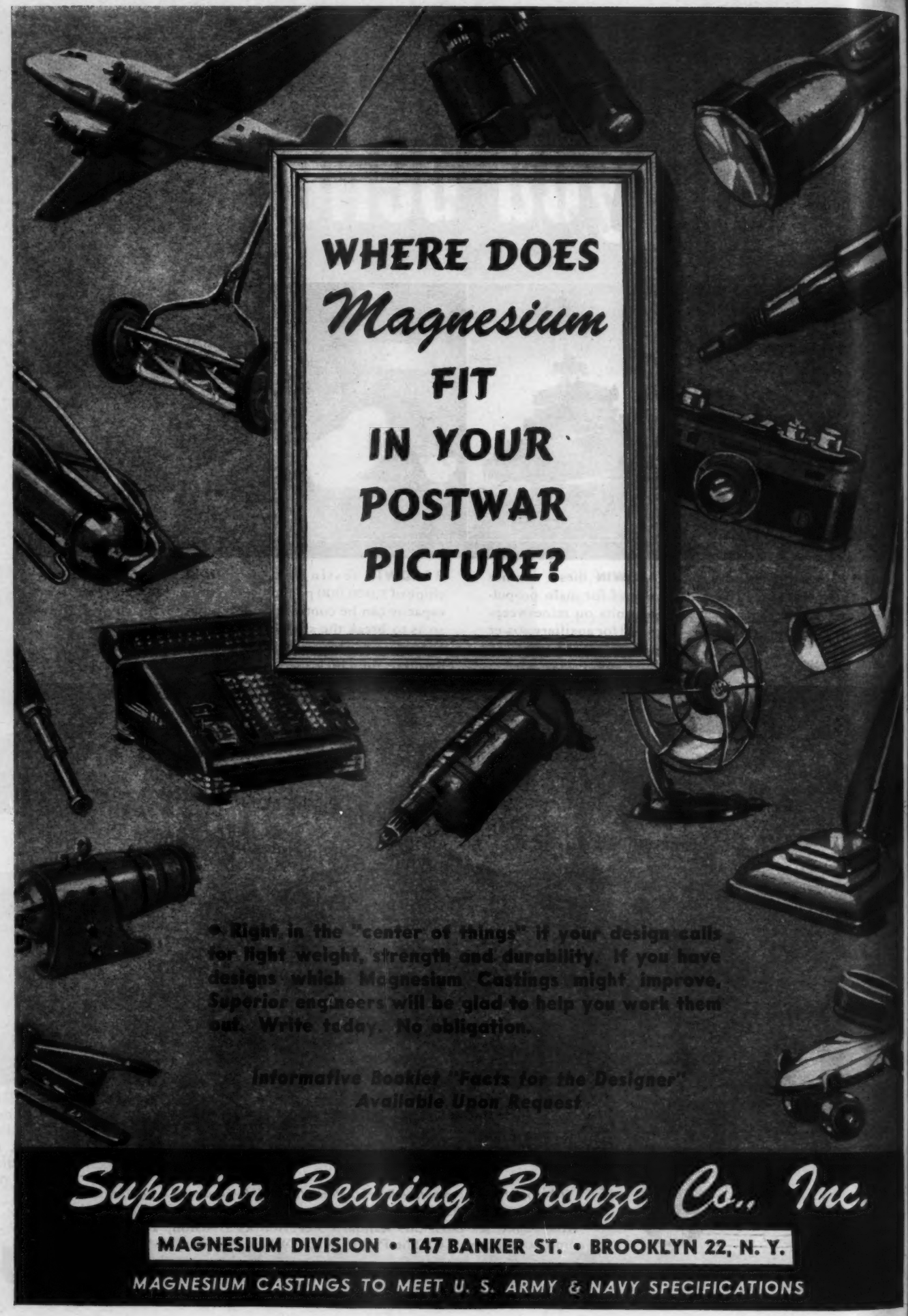
Baldwin manufactures a wide diversity of products, including testing equipment for wind tunnels, steering gears for LST landing craft, hydraulic elevators for aircraft carriers, and many other machines and instruments, serving industry on which America is depending to speed final victory.

Of course, Baldwin is well known as the builder of locomotives of all types—steam, diesel-electric and electric—doing their share of the greatest transportation job in history.

BALDWIN

BLW THE BALDWIN GROUP

The Baldwin Locomotive Works, Philadelphia, Pennsylvania: Locomotive & Ordnance Division; Baldwin Southwark Division; Cramp Brass and Iron Foundries Division; Standard Steel Works Division; The Whitcomb Locomotive Co.; The Pelton Water Wheel Co.; The Midvale Co.


WHERE DOES
Magnesium
FIT
IN YOUR
POSTWAR
PICTURE?
• Right in the "center of things" if your design calls for light weight, strength and durability. If you have designs which Magnesium Castings might improve, Superior engineers will be glad to help you work them out. Write today. No obligation.
Informative Booklet "Facts for the Designer" Available Upon Request
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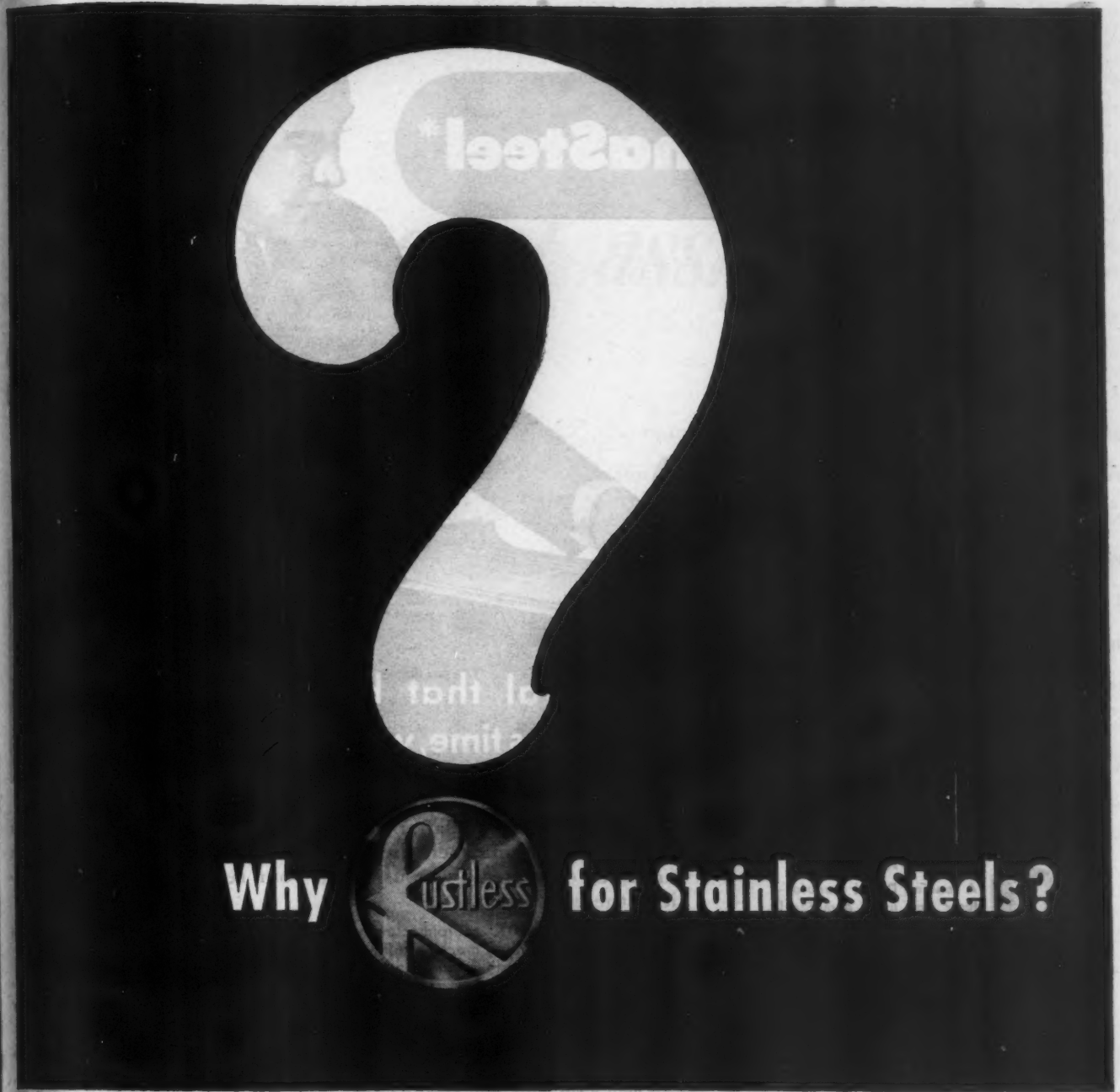
MAGNESIUM DIVISION • 147 BANKER ST. • BROOKLYN 22, N. Y.
MAGNESIUM CASTINGS TO MEET U. S. ARMY & NAVY SPECIFICATIONS



RUSTLESS has become one of the most important factors in the stainless steel industry.

One reason for this is that we specialize in the making of stainless steel, and experience has proved to American industry that it pays to deal with a specialist.

Our specialization has enabled us to work successfully with fabricators in solving manufacturing problems that involve machining, forging, cold working, welding, soldering, riveting, heat treating — or in selecting the proper type of stainless in order to obtain ease of fabrication and the economy of long, sometimes limitless life.

Your order, once you place it with us, is not just processed with standard alloy steel mill equipment. We employ many added engineering features that bring stainless steel into uniformly useful form.

Rustless makes stainless steels in over twenty grades readily available, and not only delivers billets, bars and wire, but provides detailed technical assistance with their fabrication. If you want to know more about stainless — ask Rustless.

RUSTLESS

IRON AND STEEL CORPORATION

BALTIMORE 13, MARYLAND

Producing STAINLESS STEELS *Exclusively*

SALES OFFICES: BALTIMORE
BUFFALO • CHICAGO
CINCINNATI • CLEVELAND
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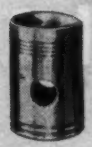
PHILADELPHIA • PITTSBURGH
ST. LOUIS • DISTRIBUTORS
IN PRINCIPAL CITIES

Design that part in ArmaSteel*

The metal that boosts output, cuts costs, saves time, when "GO-Day" comes

IN THE AUTOMOTIVE AND DIESEL INDUSTRIES

PISTONS



A leading Diesel manufacturer has used ArmaSteel pistons for years, chalking up impressive records of continuous service.

GEARS

Faster gear production through casting closer to finished dimensions and easier machining is a leading advantage of ArmaSteel.

CLUTCH THROWOUT COLLARS

The special qualities of ArmaSteel well fit it for the heavy loads and wear to which throwout collars are subjected.

The time lag from plan board to finished product can be cut sharply with ArmaSteel, the metal that has proved its mettle in hundreds of strategic war uses. In your reconversion plans consider these factors:

1. ArmaSteel is cast to conform closely to final shapes, cutting machining time, lowering cost of manufacture and reducing scrap loss.
2. ArmaSteel is much easier to machine than steel bar stock and forgings of the same Brinell hardness.
3. ArmaSteel has a uniform structure and a high yield ratio, with good fatigue and wear properties.
4. ArmaSteel responds to selective hardening by any of the commercial processes, such as induction, flame-hardening or bath immersion.
5. ArmaSteel maintains its properties at sub-zero temperatures.
6. ArmaSteel may be machined and polished to the mirror finishes so necessary to reduce friction.
7. ArmaSteel can be cast to combine several parts in one integral casting, thereby reducing machining and assembly costs.
8. ArmaSteel can be heat-treated to cover a wide range of physical properties.

Leading manufacturers have proved ArmaSteel to be an exceptionally versatile material, adaptable to varied requirements and lending itself to time-saving techniques.

Investigate ArmaSteel. It may effect savings and improvements in your product. Write us, detailing your requirements. Specify ArmaSteel in your reconversion plans.

BUY ANOTHER WAR BOND FIRST

SAGINAW MALLEABLE IRON DIVISION OF GENERAL MOTORS

SAGINAW, MICHIGAN

*Reg. U. S. Pat. Off.

Special assignment

SPECIAL ASSIGNMENTS are the orders of the day. For industry, transportation and aviation. For products of war. For our Army, Navy and Air Forces. All directed toward one goal, total and conclusive victory in the fastest possible time!

Chicago Rawhide has thrived on tough assignments for 60 odd years, creating new and improved mechanical applications for leather ... constantly helping industry and transportation solve many perplexing problems. This experience, plus continually expanding research and the invaluable aid of highly skilled, loyal craftsmen, is conscientiously being directed to designing and engineering better leather products for today *and* tomorrow — products that must be absolutely precise and perform perfectly under the most severe and constant service.

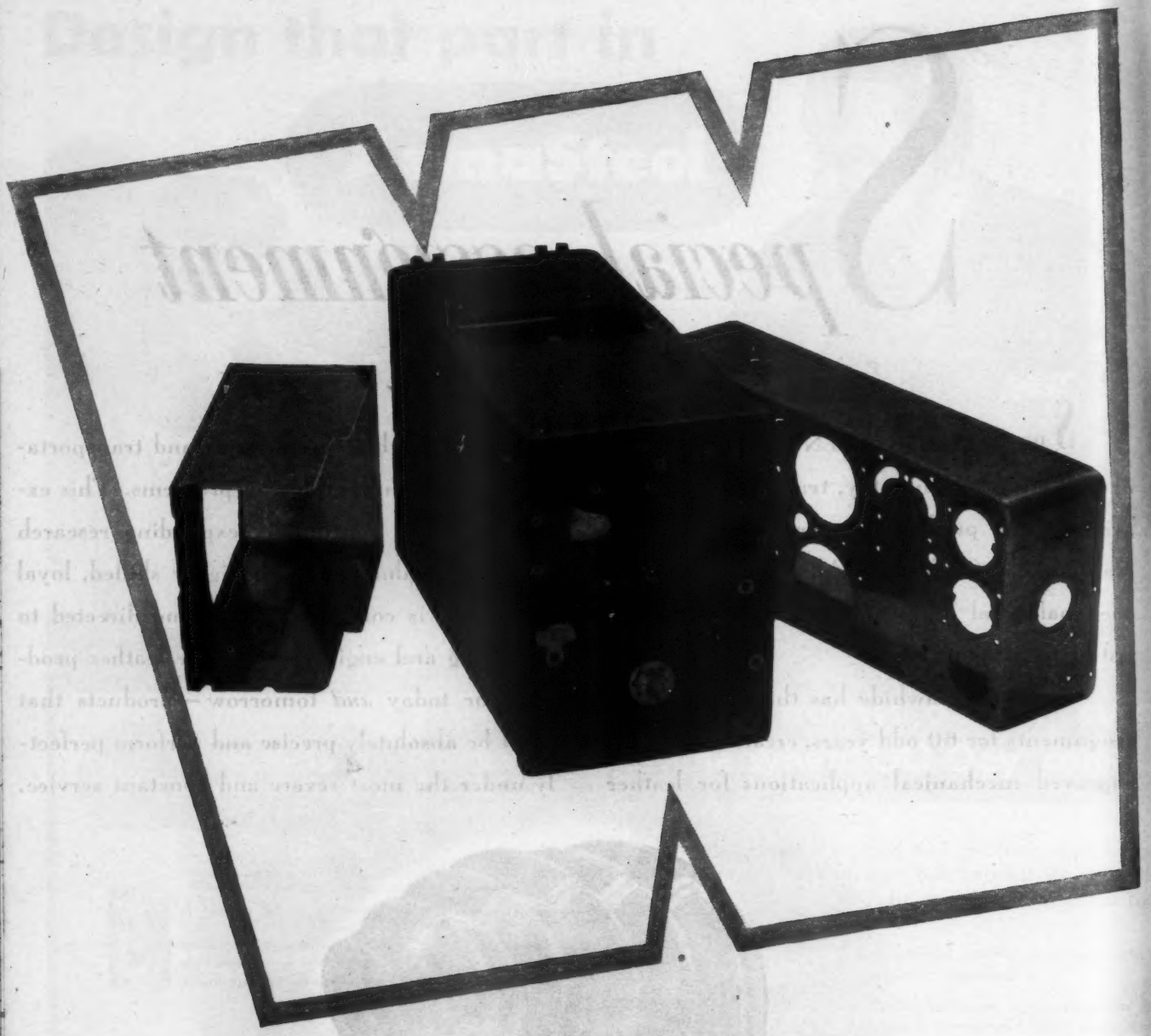
Special slide fastening leather Boot developed by Chicago Rawhide for easy assembly and quick field replacement on front wheel drive military trucks. Closes opening around ball joint to protect moving parts from dust, dirt, grit, moisture, etc., while allowing freedom of movement and extreme flexibility necessary for travel over rough ground.

CHICAGO RAWHIDE MANUFACTURING CO.

Established 1878

1301 ELSTON AVENUE, CHICAGO, ILLINOIS

DETROIT • NEW YORK • PHILADELPHIA • LOS ANGELES • PITTSBURGH • BOSTON • SYRACUSE • CLEVELAND • CINCINNATI



Close Tolerances in Light Gauge Aluminum Stampings

Stamping 100,000 intricate parts a month for Airborne Command radio sets is definitely a job for a plant with unusual facilities and thorough experience. All holes in these parts must be held to very close tolerances to prevent rattle under severe vibration. The small section shown is stamped from .020″ aluminum 52S. All corners are accurately and smoothly rounded without cracking.

Why not investigate Presteel possibilities for lowering costs and improving production on your own products by the use of metal stampings? Mail samples or prints to

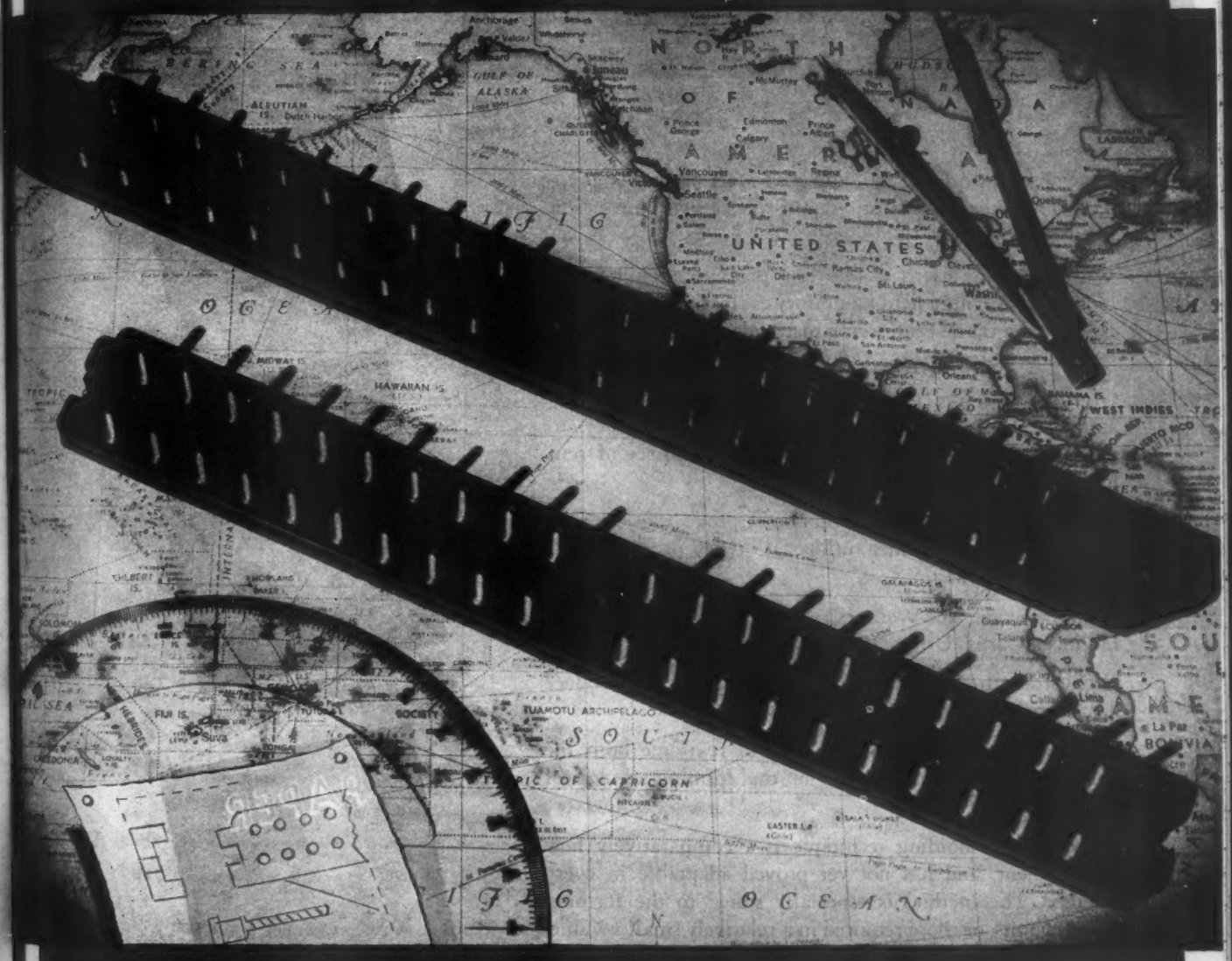
WORCESTER PRESSED STEEL CO.

712 Barber Avenue, Worcester 6, Mass.

ALLOY STEELS AND OTHER METALS COLD FASHIONED SINCE 1883

A U. S. Navy IDEA... Molded in PLASTICS

Back of the batteries of modern molding presses and precision production facilities at Tech-Art is one asset that stands pre-eminent. It is that intangible knowledge of product engineering and skill in the field of plastic production that is contained in the minds and hands of Tech-Art's engineers and craftsmen. Add to this precision mold building by Tech-Art's own master mold builders and Tech-Art's wide experience in the selection of the right plastic material for each particular product and you have the reasons for so many Tech-Art Plastic Success Stories. It is, indeed, the combination of all these factors which so often creates the hair line difference between an outstanding or mediocre success in plastic productions.



Another Plastics Success Story

Back in 1915, as the clouds of World War I loomed over Europe, the United States Navy commissioned Tech-Art's predecessors to mold a plastic electrical terminal board. It was the first—or one of the very first—plastic molded parts to withstand the rigid tests of Navy standards and to be adopted by our Navy. The 1915 and 1944 version of these units are shown above. Since 1915, through two wars and during the intervening years of peace, Tech-Art engineers and the Tech-Art organization have collaborated with the Navy in producing many highly technical plastic molded parts. Each one in itself is another plastic success story.

Quad Erat Demonstrandum

TECHNICAL NOTES: ***This molded piece is 14 inches in length with forty metallic terminal inserts molded in each unit. It is made from a non-conducting, high impact plastic material.***

36th Ave. and 41st Street • LONG ISLAND CITY, N. Y. • Tel. AStoria 8-6050-1
SUCCESSORS TO BOONTON RUBBER MANUFACTURING COMPANY
PIONEER PLASTIC MOLDERS . . . Established 1891

TECH-ART PLASTICS COMPANY

Molding

MAY BE THE ANSWER TO YOUR PROBLEM

This 18-foot hull for Army Utility Power Boats is molded in one piece of veneers and phenolic resin. Weight 245 lbs.

OUR VARIED EXPERIENCE AND EXTENSIVE FACILITIES FOR THE MOLDING OF PLYWOOD AND OTHER MATERIALS ARE AT YOUR DISPOSAL

Small parts like this resin-impregnated fiberglas capsule show the wide adaptability of the low pressure molding technique.

High grade duck, resin-impregnated, molded at low pressure in lengths up to 20' for the U. S. Armed Forces.

Light weight, high strength corrugated panel sections of paper and phenol offer interesting postwar possibilities.

Low pressure plastic molding may well provide many of the answers to Industry's post-war design and production problems.

Wartime applications of the low pressure molding technique will provide a field-laboratory evaluation of the several types of resins and reinforcing materials now known to give practical results.

Of the resins, the polyesters, phenolics, vinyls and melamines currently offer the most promise, since they are now being successfully combined with a number of reinforcing materials.

United States Plywood Corporation is producing low pressure molded parts which utilize all types of resins in a variety of combinations.

Phenolic resin and veneers produce the famous Army Engineer Corps' Utility Power Boat hull.

High strength Mitscherlich paper and phenolics produce flat, corrugated, and compound curved parts.

Fiberglas and duck are being used to reinforce both the polyester and phenolic resins in the forming of critical radar parts.

Low pressure molding technique is a comparatively new development, and has not yet proved adaptable in every instance. The method is especially suited to the forming of large units, or those required in a relatively small volume.

The extensive facilities and experienced technical staff of United States Plywood Corporation are at your disposal.

If you are interested in plywood — for any purpose — you will find the greatest variety under the Weldwood trademark. Present production includes the following types of plywood and plywood products:

Douglas Fir	Tempered Tekwood*	Armorply* Weldwood
California Pine	Northern Hardwoods	Low pressure plastics
Molded Weldwood	Southern Hardwoods	Tempreg*
Tekwood*		

*Registered trademarks

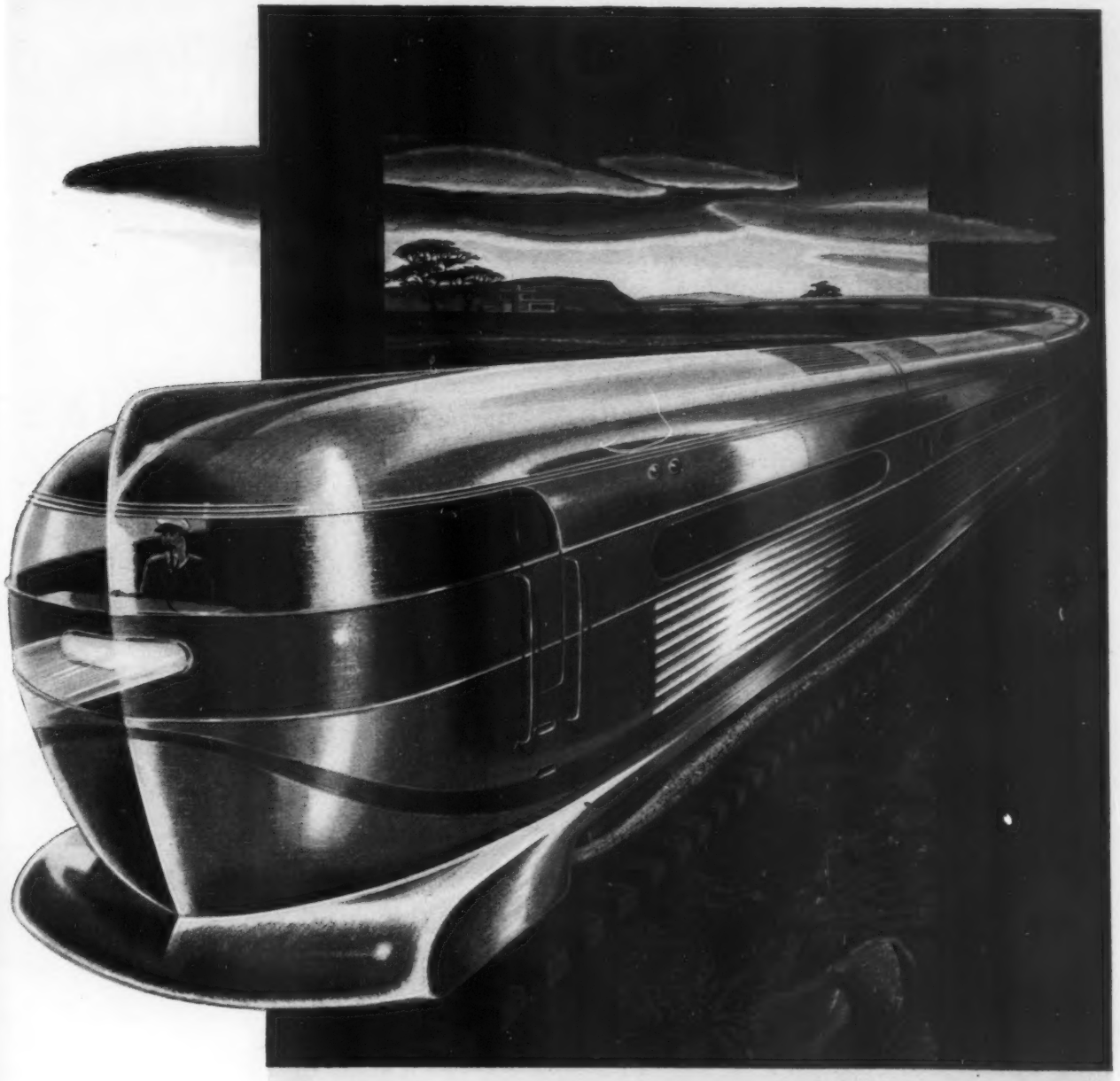
Weldwood

WELDWOOD Plywood

UNITED STATES PLYWOOD CORPORATION

World's Largest Producers of Plywood

616 West 46th Street, New York 19, N. Y. Branches in Principal Cities

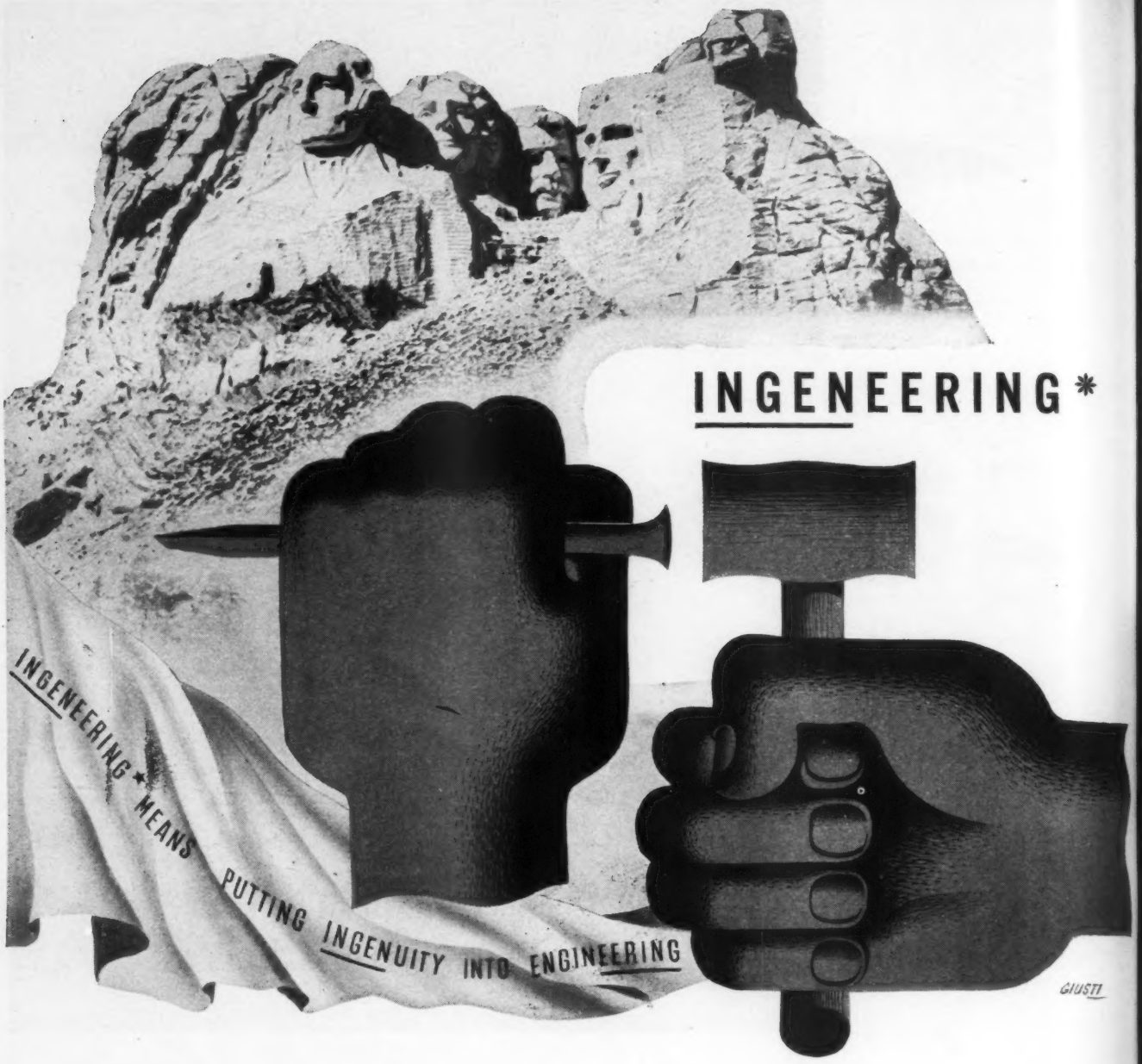


In the sunrise of post-war
Railroad Transportation

SLEEK luxury trains, gleaming with the beauty of stainless steel, fashioned in designs expressing the civilization of a peacetime world . . . they are coming, over the horizon! Ready for use in their fabrication will be Superior Stainless Strip Steel . . . *long coils* of permanently bright, solidly enduring, exceedingly strong metal, in any standard analysis and rolled to exact size . . . serving to equal advantage the designers, builders, owners of tomorrow's finer trains.

Superior
STAINLESS
STRIP STEEL

Superior Steel
CORPORATION
CARNEGIE · PENNSYLVANIA



It takes more than hands and tools and materials to create things that rise above the commonplace . . . whether in sculpture or in plastics.

It takes alert minds, willing to defy tradition, yet wise in the technique of their vocation, to make the difference. That's the *plus* you get when Victory Plastics puts INGENEERING to work to win superiority for your post-war plastics product. Write us. Victory Plastics Company, Engineer's Avenue, Hudson, Massachusetts.

INGENEERS* OF PLASTICS PRODUCTS

Victory PLASTICS COMPANY

COMPRESSION • TRANSFER • INJECTION • LAMINATION • SATURATION

COPYRIGHT 1944, VICTORY PLASTICS CO.

T&W FORGINGS

usually cost less at the point of assembly

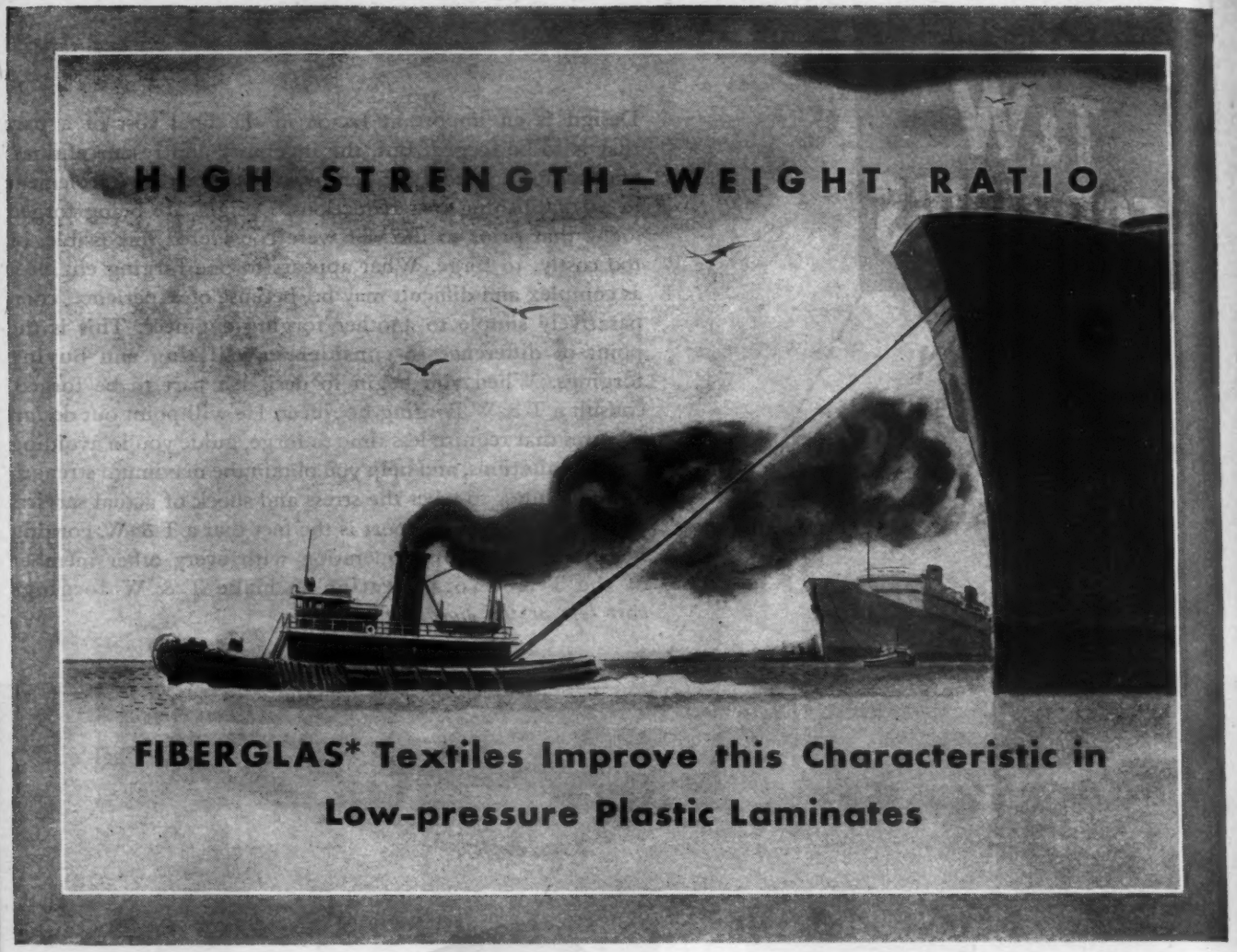
Design is an important factor in the final cost of a part that is to be forged. But, the ingenuity and resourcefulness of a forging engineer frequently proves to be the vital element in accomplishing cost reductions. Designs are being forged today that prior to the war were considered impossible, or too costly, to forge. What appears to one forging engineer as complex and difficult may be, because of experience, comparatively simple to another forging engineer. This is the point of difference to consider in utilizing and buying forgings. When you begin to design a part to be forged, consult a T & W Forging Engineer. He will point out design features that require less time to forge, guide you in avoiding many limitations, and help you obtain the maximum strength and toughness to meet the stress and shock of actual service. But of even greater import is the fact that a T & W Forging Engineer strives, in cooperation with every other member of the T & W organization to make T & W forgings *cost less at the point of assembly.*

This simple shaped design requires close control of temperature and forging operations, because the entire section of this forging must be free of all concealed defects—sound throughout—to withstand unrelenting vibration and fatigue stresses.

TRANSUE & WILLIAMS

STEEL FORGING CORPORATION • ALLIANCE, O.

SALES OFFICES: NEW YORK, PHILADELPHIA, CHICAGO, INDIANAPOLIS, DETROIT AND CLEVELAND



FIBERGLAS* Textiles Improve this Characteristic in Low-pressure Plastic Laminates

FIBERGLAS . . . is the trade name for glass manufactured in fiber or filament form by Owens-Corning Fiberglas Corporation. The Fiberglas fibers, twisted into threads and yarns, woven into tapes and cloths, provide textile materials in all the standard forms used in the reinforcement of low-pressure plastic laminates. Samples and complete technical information on Fiberglas Textiles on request. Fiberglas Corporation does not manufacture resins or finished laminates, but shall be pleased to direct you to sources of supply.

HIGH STRENGTH with LIGHT WEIGHT . . . that is the prime objective in numberless postwar products . . . plastics, in particular.

The resourceful fabricators of low-pressure laminates are setting up new highs in the vital strength-weight ratio. They are reporting notable improvements in the strength-to-weight factor through the use of Fiberglas Cloth Reinforcements in combination with the new contact pressure resins.

Fiberglas . . . glass in the form of fine fibers or filaments . . . has a specitic tensile strength beyond that of steel. Twisted into yarns, woven into Fiberglas Cloth and put into plastic laminates for reinforcement, Fiberglas carries its high strength with it. Fabricators are producing laminates with strength-weight ratios in excess of those of the high-strength metals.

And they are reporting that Fiberglas Cloth contributes in an important way to other desirable properties in finished laminates, such as impact strength, dimensional stability, moisture resistance.

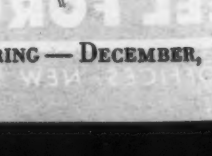
If you are working to build up strength-weight ratios and other qualities in plastic laminates, you may find it highly profitable to look into Fiberglas Cloth and the results that are being achieved with it in combination with some of the new resins.

As a first step, write for reprints of published reports of comprehensive investigations of Fiberglas-reinforced, low-pressure laminates by the U. S. Army Air Forces. Address your request to *Owens-Corning Fiberglas Corporation, 1878 Nicholas Building, Toledo 1, Ohio. In Canada, Fiberglas Canada Ltd., Oshawa, Ontario.*

FIBERGLAS

*T. M. Reg. U. S. Pat. Off.

. . . A BASIC MATERIAL



Fuel Tanks of Navy "Coronado" Patrol Bombers

Sealed with PRESSTITE SEALING COMPOUNDS

Many a tale has been told of the great work being accomplished by the Navy's PB2Y's—known as "Coronado" Patrol Bombers—in jobs ranging from bombing missions to heroic surface rescues. The fuel tanks of the Navy transport version of this type of plane, designated PB2Y-3R, are resealed by the Rohr Aircraft Corp. of Chula Vista, California.

Integral Fuel Tanks in these giant ships, the largest mass-produced plane in Navy service, are sealed with Presstite sealing materials using the Rohr Tank Seal Process. This method of sealing integral tanks, developed by Rohr Aircraft Corp., using these proven Presstite materials, represents the latest development in sealing tanks in large transport, cargo, and similar type planes.

Meeting the complex sealing requirements of the aircraft industry is only one example of Presstite's ability to originate and develop sealing compounds for specific requirements.

If your product or your manufacturing processes call for sealing or coating compounds, send your requirements to sealing specialists. We'll gladly work with you and your engineers in suggesting the most effective compounds to fit your needs.

PRESSTITE
SEALING COMPOUNDS

PRESSTITE ENGINEERING COMPANY, 3956 Chouteau Avenue, St. Louis 10, Missouri

A Partial List of Industries for Which Presstite has successfully Developed Special Sealing Compounds:

For the Aircraft Industry:
Sealers for
Integral Fuel Tanks
Fuselage Seams
Drop-off, Expendable Fuel Tanks
Gun Turrets
Synthetic Glass
Instruments
Intercoolers
Air Ducts
Insulating Dissimilar Metals
Seaplane Floats

For the Refrigeration Industry:
Sealers for Domestic and Commercial Refrigerators
Bonding and Sealing Low Temperature Insulation in Refrigerated Rooms

For the Railroads:
Sealers for Insulating, Soundproofing and Weatherproofing of Railway Cars—Sealing Car Windows and Spot Welded Seams

For the Building Industry:
Roof Coatings, Caulking, and Waterproofing Compounds

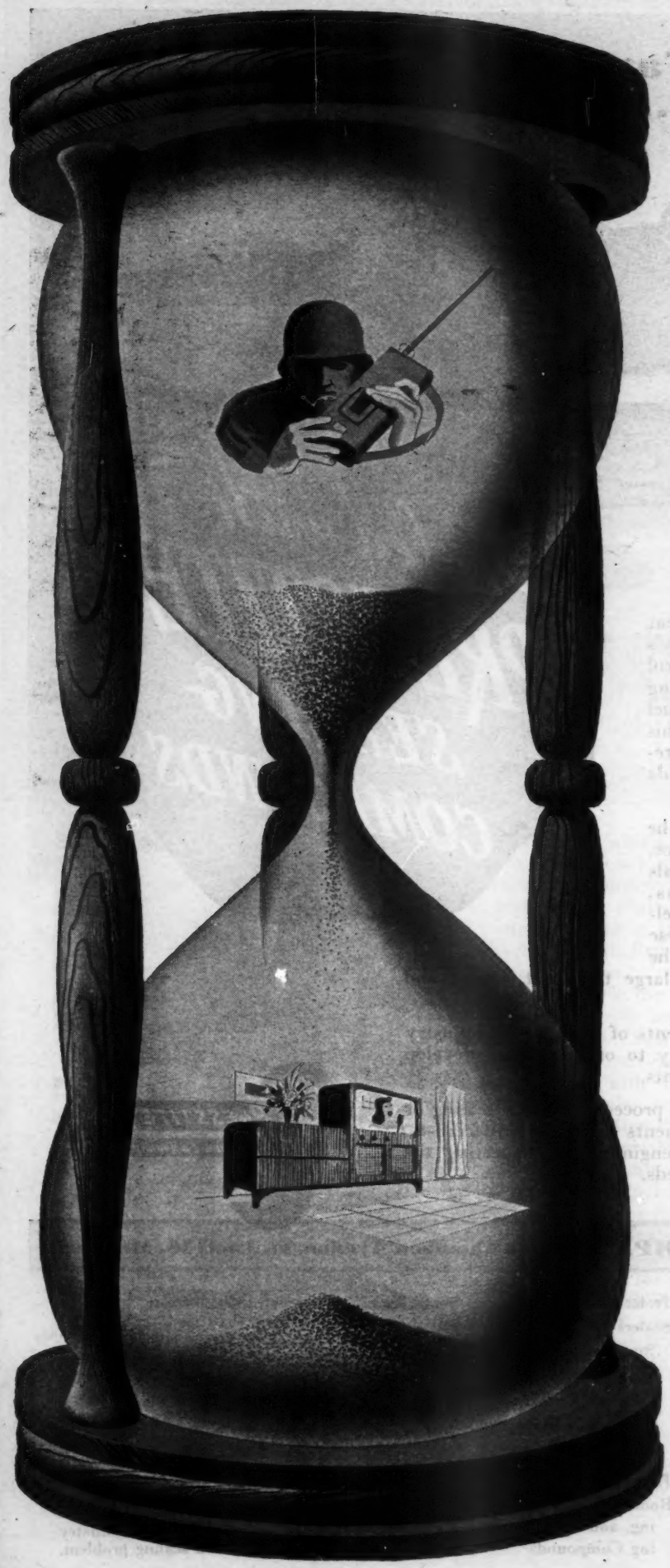
For the Shipbuilding Industry:
Insulation Adhesive and Sealers — Rust Preventive Compounds

For the Automotive Industry:
Special Adhesives and Sealers

For the Construction Industry:
Sealers for Jointing Sewer Pipes
Sealers for Waterproofing Excavation Work

Miscellaneous:
For Glazing Greenhouse Windows
Extruded Caulking Compounds
Ammunition Paints
Plus Many Special Products for the Army and Navy

Our Engineering, Technical, and Laboratory facilities are at the service of any industry with a sealing problem.



WILCO facilities Expanded to Meet Wartime Needs!

But Postwar Industry will be the ultimate gainer from the many new WILCO products and developments

As the Hourglass indicates . . . at the coming of peace, the skill and experience gained in the development and application of new WILCO products and techniques will mean much to automotive, electrical appliance and many other types of manufacturing customers.

Though now chiefly applied to the war effort, these new WILCO developments are destined to play as vital a role in the postwar industrial "comeback" as they are now playing in scores of wartime applications.

Thermostatic Bimetals, Electrical Contacts, and Precious Metal Bimetallic Products are such important factors in the precision performance of ships, planes, tanks, guns, and various instruments of the Army and Navy that the H. A. Wilson Company has found it necessary to enlarge its facilities and develop these important new products and techniques.

In the postwar period no company will be better equipped to meet individual requirements for Thermostatic Bimetals and Electrical Contacts on any desired scale than the H. A. Wilson Company, pioneers in this field.

WILCO PRODUCTS ARE: *Contacts*—Silver, Platinum, Tungsten, Alloys, Sintered Powder Metal. *Thermostatic Bimetal*—High and Low Temperature with new high temperature deflection rates. *Precious Metal Collector Rings* for rotating controls. *Silver Clad Steel. Jacketed Wire*—Silver on Steel, Copper, Invar, or other combinations requested. *Rolled Gold Plate.* Special Materials.

THE H. A. WILSON COMPANY
105 Chestnut Street, Newark 5, New Jersey

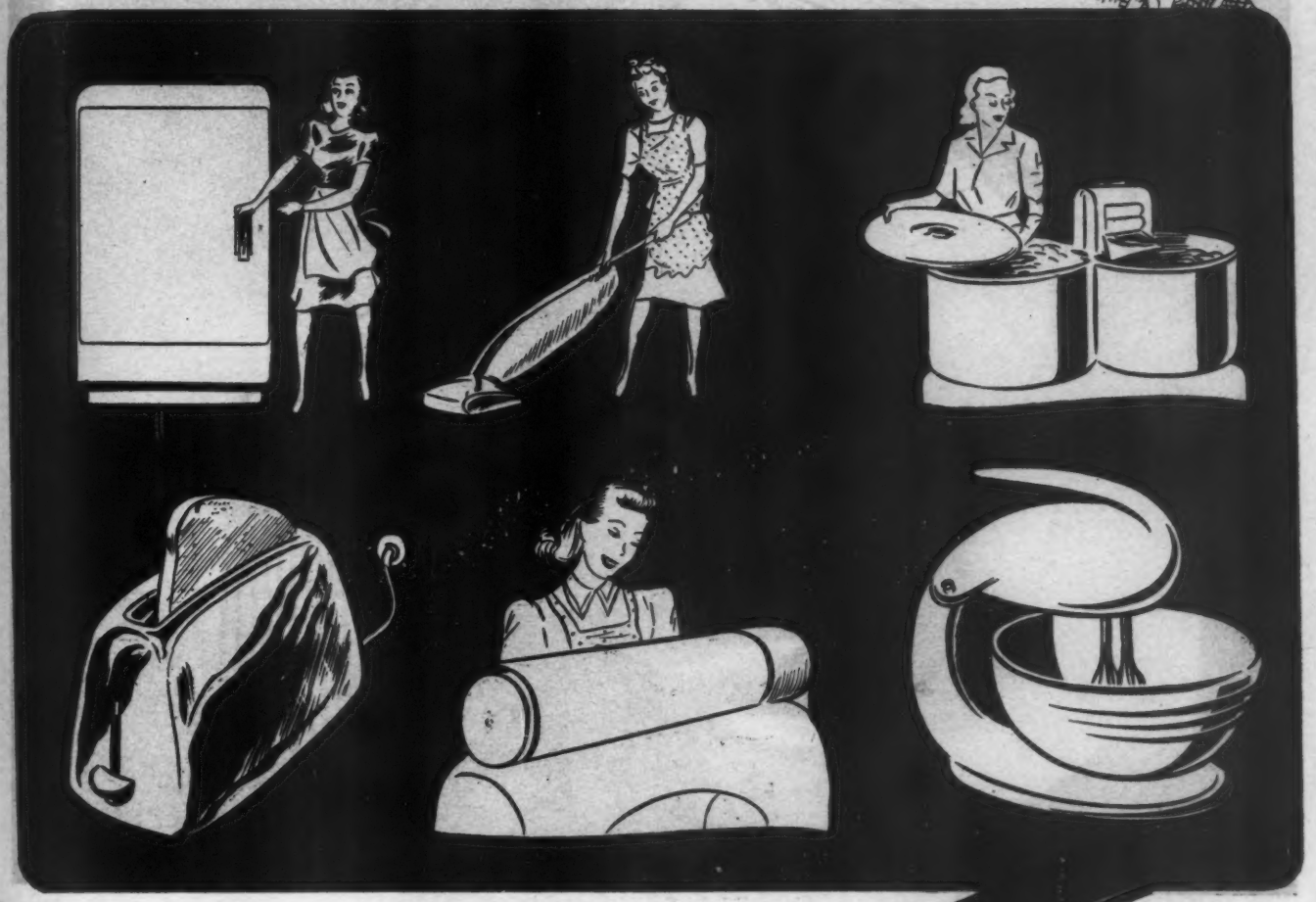
WILCO

Thermometals—Electrical Contacts
Precious Metal Bimetallic Products

GRAPHITAR Bearings, Vanes and Moving Parts

(CARBON-GRAPHITE)

Make Household Appliances Work *Quietly*



GRAPHITAR, the non-metallic carbon-graphite material has many unusual properties which make it efficient for decreasing friction, maintenance and, especially, noise in household appliances. Small bearings, vanes, pistons and seals made of Graphitar have greatly improved the quietness of operation of toasters, refrigerators, vacuum cleaners, washing machines and mangles.

Graphitar is chemically inert. It effectively resists acids, gases, and chemicals of all kinds. Self lubricating, Graphitar has a low coefficient of friction. Graphitar parts take on a high polish and operate indefinitely with little or no lubrication.

Graphitar is mechanically strong yet extremely light. Its lightness approaches that of magnesium. Manufactured in several basic grades, Graphitar may be ground to tolerances as close as .0005" on small sizes.

In scores of widely varied consumer and industrial products, Graphitar has proven its worth. Write today for 24 page illustrated book of facts.

GRAPHITAR

(CARBON-GRAPHITE)

THE UNITED STATES GRAPHITE COMPANY • SAGINAW, MICHIGAN

die making vs die design..

Die design represents the basic framework of custom injection moulding — an art even finer than that of die making. A well conceived, properly designed mould may far outproduce a more complicated die. The piece price will be lower too. It is this faculty of die design which has drawn scores of manufacturers to the Trio and which should mark your first consideration of a plastic moulder.

For Custom Injection Moulding . . . try the Trio

ARMY E NAVY

Custom Injection Moulders

WORCESTER MOULDED PLASTICS COMPANY

8 GRAFTON STREET WORCESTER 8, MASSACHUSETTS
17 EAST 42nd ST., NEW YORK 17, N. Y.

BETTER PRODUCTS OF TOMORROW . . FROM COPPER

Copper has always set the standard by which all other metals or "substitutes" have been judged. The Hussey Copper that you will specify in the fabrication of your post war products, will set an even higher standard—thanks to the new war-developed and war-proved copper that provides greater resistance against corrosion, constant uniformity and easier workability.

The technical facilities of the Hussey organization are available to you now—to aid in applying this advanced knowledge and experience with these new materials, to every post war product development.

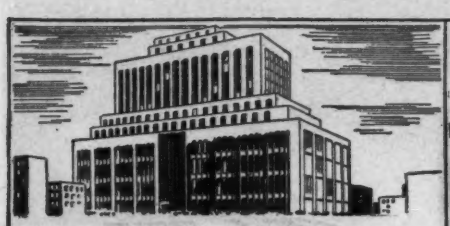
C. G. HUSSEY & COMPANY

(Division of Copper Range Co.)

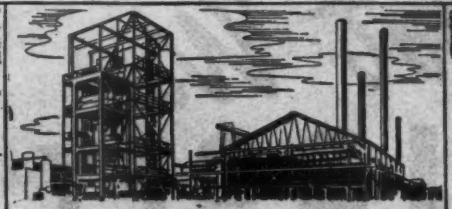
Rolling Mills and General Offices: PITTSBURGH, PA.

Warehouses in Principal Cities

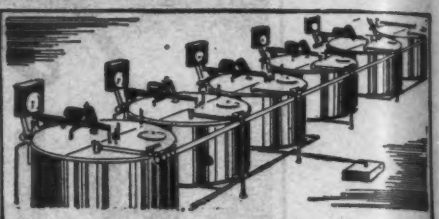
Stainless Steels Are Specified For These Applications:



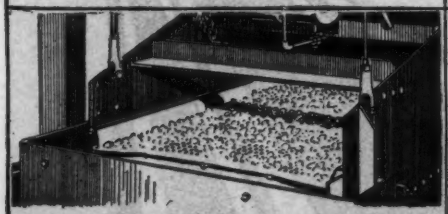
Architecture — For weatherproof exterior trim, stainless steel is not excelled in beauty or length of life.



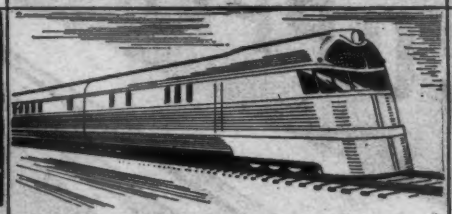
Refineries — Furnace tubes, carrying corrosive gases at high temperatures, are made of stainless steel.



Food processors — Stainless steel milk processing equipment will not taint milk and is easily kept sanitary.

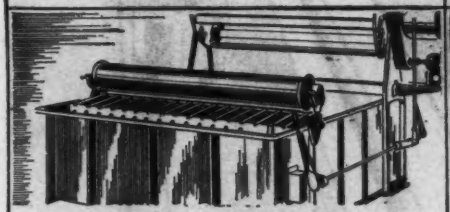


Mining — Vibrating screens of stainless steel resist abrasion and wear to give extra life.

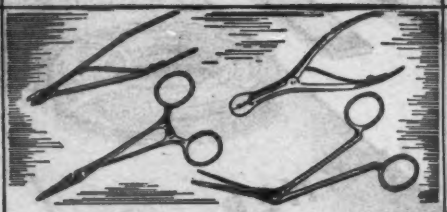


Transportation — Railroads use light-weight passenger equipment built of stainless steel.

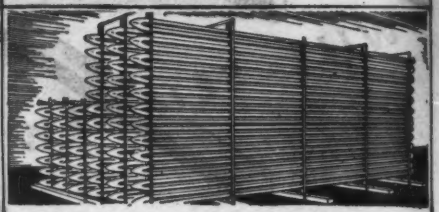
Power Plants — Stainless steel turbine blades resist corrosion and erosion of steam at high temperatures.



Textile mills — Quickly cleaned stainless steel dye vats make possible a rapid succession of dye baths.



Hospitals — Stainless steel surgical instruments resist corrosion from repeated high-temperature sterilization.



Chemical plants — Highly corrosive nitric acid is handled safely in a stainless steel condenser.

Have You Considered Using Stainless Steel?

• These are only some of the uses of stainless steel, but they may suggest how stainless steel can serve you. Although we do not make stainless steel or steel of any kind, we have had 37 years of experience in the manufacture of ferro-alloys used in the production of steel. Working closely with the steel companies and the users of stainless steel, our engineers have accumulated information on the use of stainless steel in many industries. If you want more specific details about a particular application, write to us.

BUY UNITED STATES WAR BONDS AND STAMPS

ELECTRO METALLURGICAL COMPANY
Unit of Union Carbide and Carbon Corporation
30 East 42nd Street — New York 17, N. Y.
In Canada: Electro Metallurgical Company of Canada, Limited, Welland, Ontario

Electromet
Trade Mark
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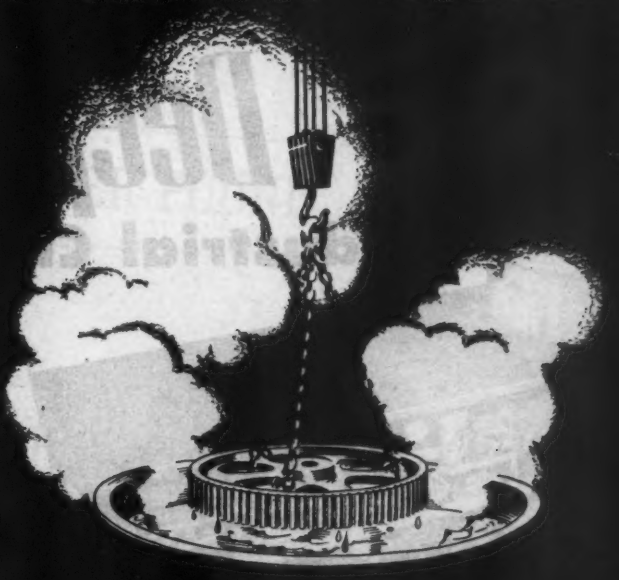
BETTER STEEL CASTINGS THROUGH RESEARCH



What Changes Quenching Makes!

Research has developed many ways of improving upon nature herself—of giving to steel castings characteristics and properties which may be predicted in advance, to meet known requirements.

In a few seconds, the metal structure of a steel casting can be completely changed—by heating it to a certain predetermined temperature and then immersing it quickly into a quenching medium. The principle is old, but many of its applications are new, as they affect larger, more complex designs, and meet new conditions.

So precisely has the science of heat treatment been worked out that it is now possible to control its effects within very exact limits. Cast steel responds to heat treatment equally as well as steel in any other form. Varying degrees of hardness can be given to the surface of a casting, to any desired depth, or to any section of the casting which requires special properties.

Often steels may be given, by properly controlled heat treatment, properties formerly obtained only by costly alloys.

This has been particularly important in war production, where entirely satisfactory results have been secured in spite of shortages of many important alloying agents.

Research now permits the user to buy his steel castings by prescription as accurate as a doctor's prescription.

As you look into the future, planning what you will make and what you expect to make it out of, consider this wide adaptability of steel castings, which enables them to meet an infinite range of conditions, with economy and with certain results.

Published by the Steel Founders' Society of America, to tell you about its organized Research Program.

MODERNIZE AND IMPROVE YOUR PRODUCT WITH

STEEL CASTINGS

Deepfreeze Cascade —120° F. Industrial Chilling Machine designed for numerous high production cold treating operations.

GAUGE GROWTH ELIMINATED

AFTER *Cold Treating* IN A

Deepfreeze

Industrial Chilling Machine

"H" type pin gauges completely stabilized by cold treating.

In Addition, Gauge Life Lengthened as a Result of Increased Metal Hardness

Here is a typical example of how manufacturers are using cold treating to stabilize gauges and other precision machine parts. Under conventional production methods the "H" type pin gauges shown above grew as much as .001" to .0015" while stored in tool cribs. Now, after cold treating, at −120° F. in a Deepfreeze Industrial Chilling Machine before final machining, the gauges hold their original dimensions for indefinite periods of time. In addition, the increased hardness of the metal obtained in the same cold treatment resulted in improved wearing quality of the gauges.

COLD TREATING FACTS

MACHINE—Deepfreeze — 120° F. Industrial Chilling Machine.

PART—"H" type pin gauges.

GAUGE SIZES—3.000 4.330, 5.000, 6.250, 7.000.

MATERIAL—S.A.E. 1095 Carbon Tool Steel for gauging blocks; cross piece from cold rolled bars.

TREATING PROCEDURE—(1) Heat to 1450° F.; (2) water quenched; (3) immersed in water approximately 210° F. for 1 ½ hours; (4) return to room temperature; (5) transfer to Deepfreeze at — 120° F. for 1 ½ hours; (6) return to room temperature; (7) given a draw of 375° F. for 1 ½ hours; (8) cooled to room temperature; (9) return to Deepfreeze for 1 ½ hours; (10) return to room temperature; (11) immersed in hot water at 210° F. for 1 ½ hours; (12) return to room temperature; (13) again cold treated in Deepfreeze at — 120° F. for 1 ½ hours; (14) return to room temperature; (15) finished ground to size.

NOTE: Every effort was made to make the rise and fall of the temperature continuous without any prolonged rest between the hot and cold point reached.

RESULTS: These gauges were checked for size immediately after cold treatment, then four months later, and once again two months later. It was found that growth was held to a maximum of .00004" as compared to the previous growth of .0015."

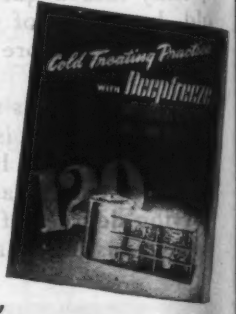
How Others Are Using Cold Treating

Cold treating is being practically applied at present by numerous manufacturers of diversified products for the following purposes:

Treating of high-speed steel cutting tools.
Shrinking of metal.
Shrink-fit assembly.
Stabilization of gauges.
Hardening precision machine parts.
Testing of aircraft instruments and materials.
Testing of lubricants, paints, plastics, chemicals, synthetic rubber and pharmaceuticals.

FREE *Complete, Up-to-date Cold Treating Information...*

Our new 40-page booklet covers every phase of cold treating from its inception to the present time. It gives specific information on how such manufacturers as Curtiss-Wright Corporation, Cincinnati Milling Machine Company, Ford Motor Company, Savage Tool Company, Kearney & Trecker Corporation, and many other Deepfreeze users are applying cold treating to their production. Write today for Bulletin No. 1-4.



Only Motor Products can make a "DEEPFREEZE"

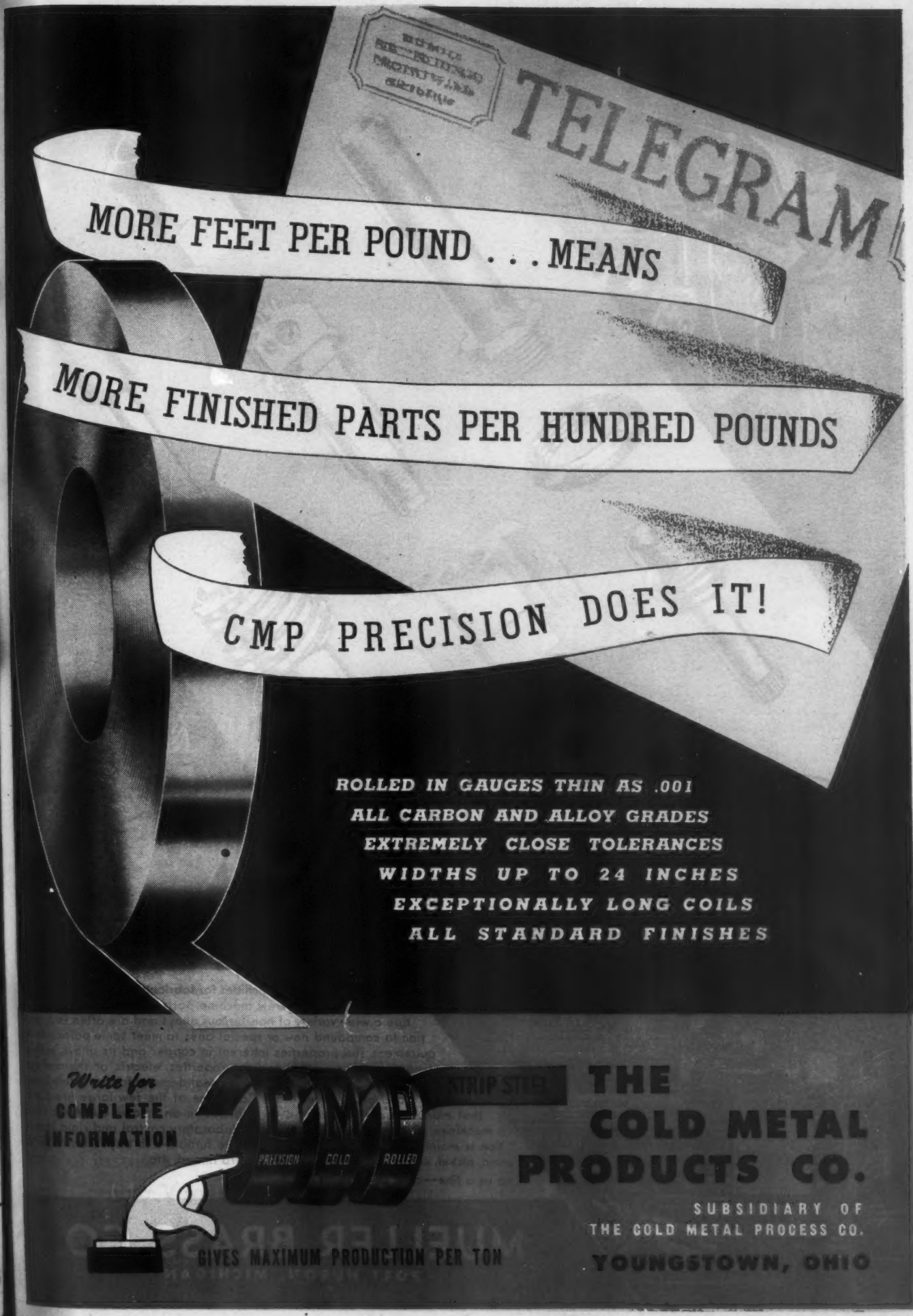
Deepfreeze

2326 DAVIS STREET
NORTH CHICAGO, ILLINOIS

TRADE MARK DEEPFREEZE REGISTERED UNITED STATES PATENT OFFICE

Industrial Chilling Equipment for Shrinking, Testing, Hardening and Stabilizing Metals

Division of Motor Products Corporation, Detroit, Mich


TELEGRAM
MORE FEET PER POUND . . . MEANS
MORE FINISHED PARTS PER HUNDRED POUNDS
CMP PRECISION DOES IT!
ROLLED IN GAUGES THIN AS .001
ALL CARBON AND ALLOY GRADES
EXTREMELY CLOSE TOLERANCES
WIDTHS UP TO 24 INCHES
EXCEPTIONALLY LONG COILS
ALL STANDARD FINISHES
Write for COMPLETE INFORMATION
CMP
PRECISION COLD ROLLED
STRIP STEEL
GIVES MAXIMUM PRODUCTION PER TON
THE COLD METAL PRODUCTS CO.
SUBSIDIARY OF
THE COLD METAL PROCESS CO.
YOUNGSTOWN, OHIO

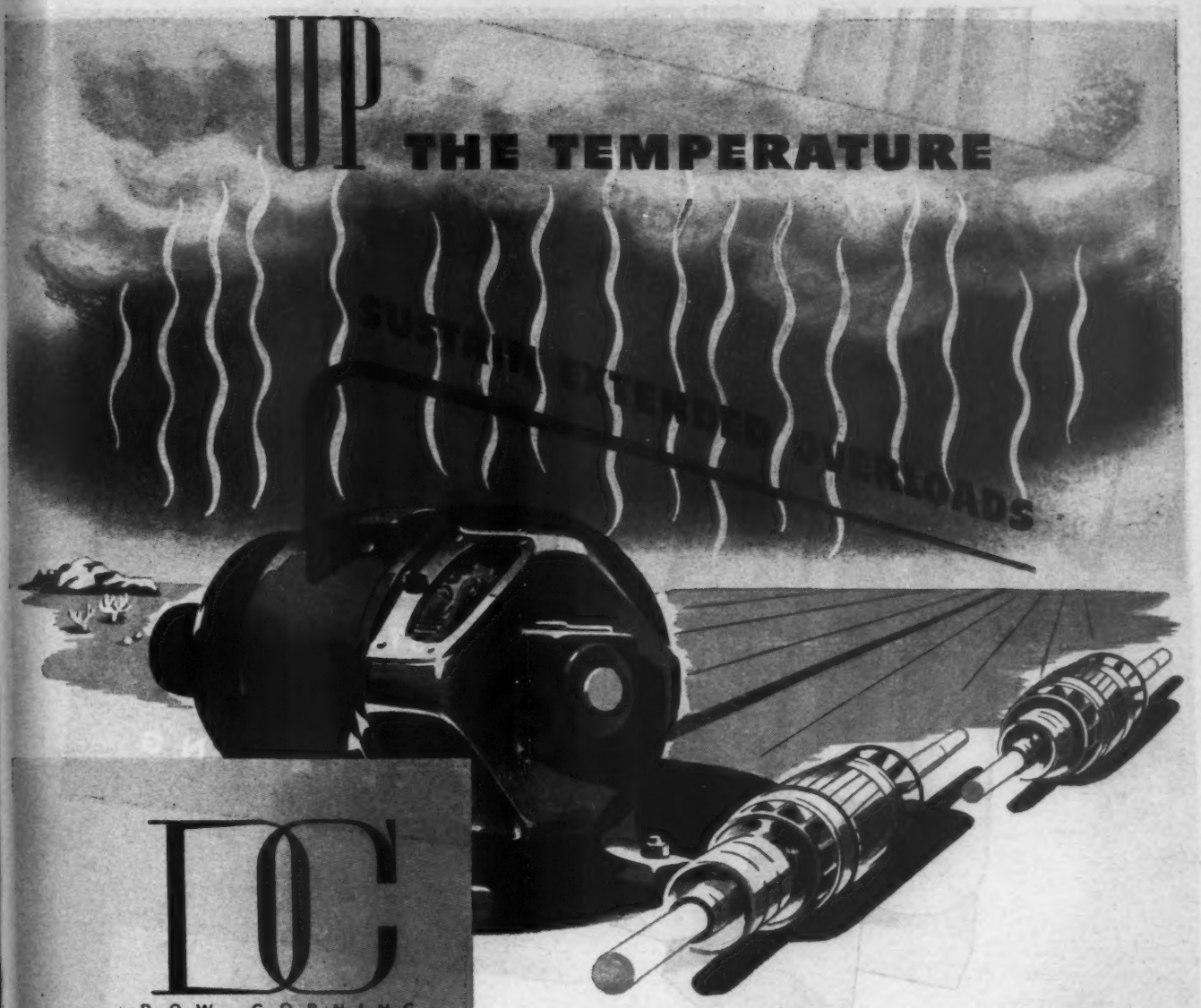
IN SCREW MACHINE PARTS

We have complete facilities for fabricating brass, bronze, copper or aluminum screw machine parts. We regularly manufacture a wide variety of non-ferrous alloys and are often in a position to compound new or special ones to meet some particular requirement. The properties inherent in copper and its alloys, such as resistance to corrosion, bearing properties, electric or thermal conductivity, machinability, etc., create a great demand for parts fabricated in these materials. Mueller Brass Co. is one of the few large brass mills that manufactures its own rod for fabrication on its own automatic screw machines. All operations are under strict laboratory control and rigid inspection is maintained. Screw machine parts are furnished in any finish required, plain, nickel, chrome, cadmium plated, electro tinned, etc.

Drop us a line—send us samples or blueprints.

MUELLER BRASS CO.

PORT HURON, MICHIGAN



DOW CORNING

VARNISHES

High Temperature Silicone Insulation

Dow Corning Silicone Varnishes are helping to create a new class of insulation—insulation in a class by itself for thermal stability, moisture resistance and freedom from overload failures.

They provide the bonding and filling medium for inorganic, or Class B, spacing materials such as Fiberglas, asbestos and mica, which are natural components of this type of insulation.

Dow Corning Varnishes open the avenue to the designing of more compact, lighter weight electrical equipment.

DOW CORNING 993 . . . available in commercial quantities, is a heat curing, high temperature stable silicone varnish for impregnating motor stators, transformer coils and other electrical equipment; for varnishing Fiberglas or asbestos served magnetic wire; for varnishing Fiberglas and asbestos electrical insulating cloths, tapes, tying cords and sleeving; for bonding Fiberglas and mica combinations.

DOW CORNING CORPORATION
BOX 592, MIDLAND, MICHIGAN

Dow Corning

Eliminate..
THESE COSTLY OPERATIONS
IN YOUR POST-WAR PRODUCTION
HEAT TREATMENT AFTER MACHINING
DISTORTION
STRAIGHTENING
CLEANING
..through the use of
WYCKOFF
HEAT TREATED COLD FINISHED BARS
Pause for a moment and consider the sizable savings in time, money and equipment you could effect in your post-war products by the elimination of these costly operations—through the use of Wyckoff Heat Treated, Cold Finished Steel Bars. Tremendously successful in peacetimes, a "must" in World War II, Wyckoff metallurgical engineers will gladly demonstrate why Wyckoff Heat Treated, Cold Finished Bars are being specified on so many post-war blueprints.
WYCKOFF STEEL COMPANY
General Offices: PITTSBURGH 30, PENNA.
Works: AMBRIDGE, PENNA.; CHICAGO, ILL.; NEWARK, N. J.; PUTNAM, CONN.
Manufacturers of Carbon and Alloy Steels... Turned and Polished Shafting... Turned and Ground Shafting... Wide Flats up to 12" x 2"... Complete Annealing and Heat Treating Facilities.
COLD FINISHED STEEL
WYCKOFF
ARMY E NAVY

TUNED TO TODAY'S PRODUCTION NEEDS

DURITE

P L A S T I C S

● **RESINS** . . . Phenol-Furfural and Phenol-Formaldehyde Resins. Other synthetic resins of many types for all purposes, including low pressure molding.

● **MOLDING COMPOUNDS** . . . Complete line of Phenol-Furfural and Phenol-Formaldehyde molding powders.

● **CEMENTS** . . . Bonds of remarkable strength for metal, wood and thermoset plastics. Cold-setting boil-proof plywood and wood bonds.

● **ADHESIVES** . . . Hot and cold-setting, for plywood, paper, glass, cloth and fibre; textile sizing and proofing; paper manufacturing, also, for wet strength and proofing purposes.

● **OIL SOLUBLE RESINS** . . . For production of air-drying or baking varnishes, protective coatings, and finishes.

● **WATER SOLUBLE RESINS** . . . For hot and cold molding, high and low pressure molding, and wet web impregnation.

● **NEW PROCESSES** . . . Dry impregnation, nozzleless injection molding, continuous thermosetting injection molding.

OUR EXPERIENCE IS AVAILABLE TO YOU

DURITE PLASTICS

INCORPORATED

FRANKFORD STATION P. O. PHILADELPHIA 24, PA.

REPRESENTATIVES LOCATED AT:

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1274 Folsam St., San Francisco 3, Cal.

67 Lexington Ave., Buffalo 9, N. Y.

352 Plymouth Road, Union, New Jersey

245 W. Franklin St., Morrisville, Pa.

2711 Olive St., St. Louis 3, Mo.

4851 S. St. Louis Ave., Chicago 32, Ill.

Trademark Reg. U. S. Pat. Off.

Globeiron SEAMLESS TUBING

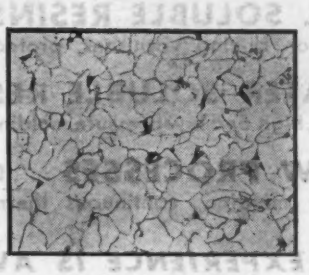
- **FOR HIGH MAGNETIC PERMEABILITY**
- **GREAT DUCTILITY AND TOUGHNESS**
- **CORROSION RESISTANCE . . . .**

Globeiron fills a long-felt want and is gaining wide popularity because of its unusual characteristics — high magnetic permeability, uniform ductility, softness, and toughness. It is a high purity, low carbon iron. Such irons often are known as "ingot irons." They also might be classed as extremely low carbon, open hearth steels.

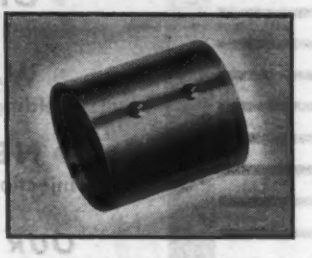
Globeiron is a very soft and ductile metal which can be fabricated cold into almost any form. Because of its purity, it has electric and magnetic properties approaching those of pure iron. Its magnetic permeability is much better than that of mild steel. It is recommended for motor and generator housings where permeability is a factor. Such parts may be made thinner and lighter than when low carbon steel is used.

Wherever corrosive attack is accelerated by segregations, and nonhomogeneity in steels, Globeiron tubing is superior to steels.

Globeiron is a development of Globe engineers, whose services are freely available for counsel in the selection of the tubing with the exact characteristics demanded for any service. We are specialists in the manufacture of steel tubes. Our unusual laboratory facilities and production capacity assure quality control and economy.



• Under the microscope Globeiron shows a uniform structure of almost pure ferrite with only occasional patches of pearlite.



• Housings for generators and motors may be thinner and lighter when made of Globeiron instead of low carbon steel.

You always can get the right tubing for the job by calling on Globe engineers for assistance in solving specific problems.

★ STAINLESS TUBES
★ BOILER TUBES
★ GLOBEIRON TUBING
★ GLOWELD TUBES

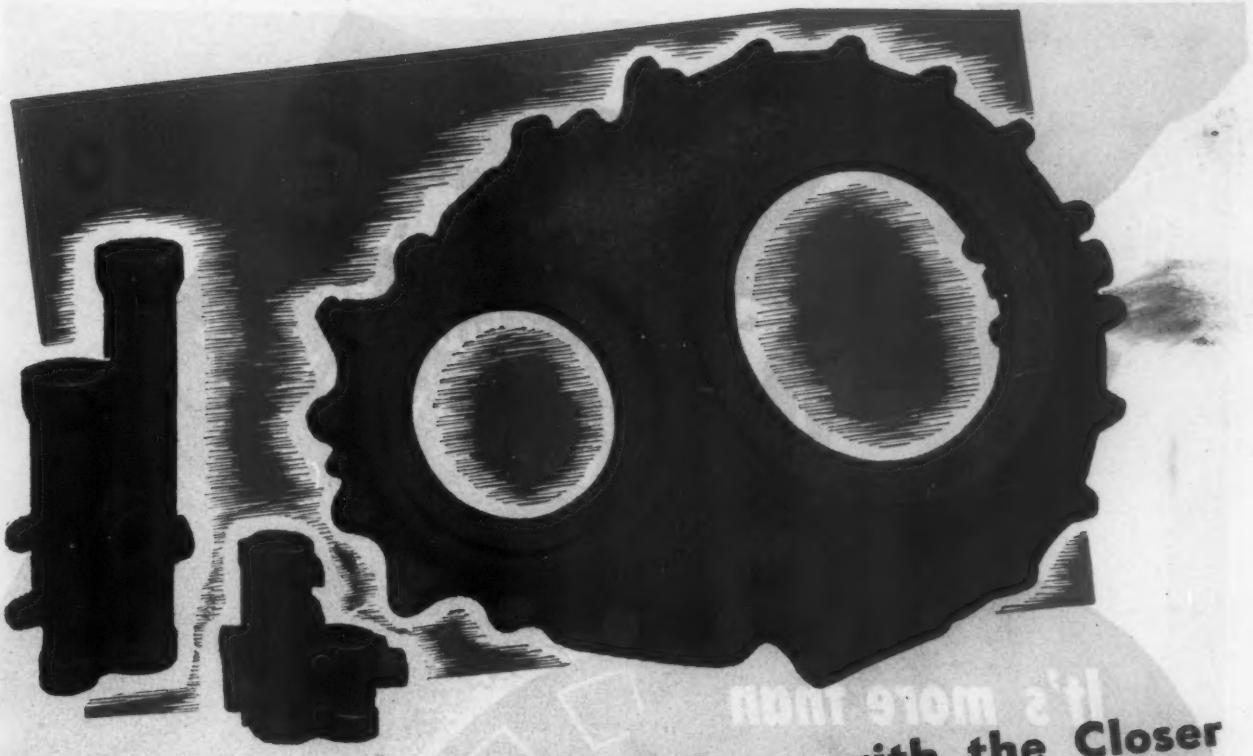
GLOBE TUBES

★ CONDENSER AND HEAT EXCHANGER TUBES
★ MECHANICAL TUBING

GLOBE STEEL Tubes

1102

GLOBE STEEL TUBES CO., Milwaukee 4, Wis., U. S. A.



Costs DOWN . . . Production UP . . . with the Closer Precision of Permite PERMANENT MOLD Castings

★ The price of an aluminum casting is often only a fraction of the cost of finishing it. And it is in reducing your finishing cost that Permite Permanent Mold Aluminum Castings offer you important savings. Permanent mold castings are more precise in dimension (tolerance is ± .01" against ± .03" in sand castings). And because every casting is poured in the same permanent metal mold, all castings are dimensionally uniform.

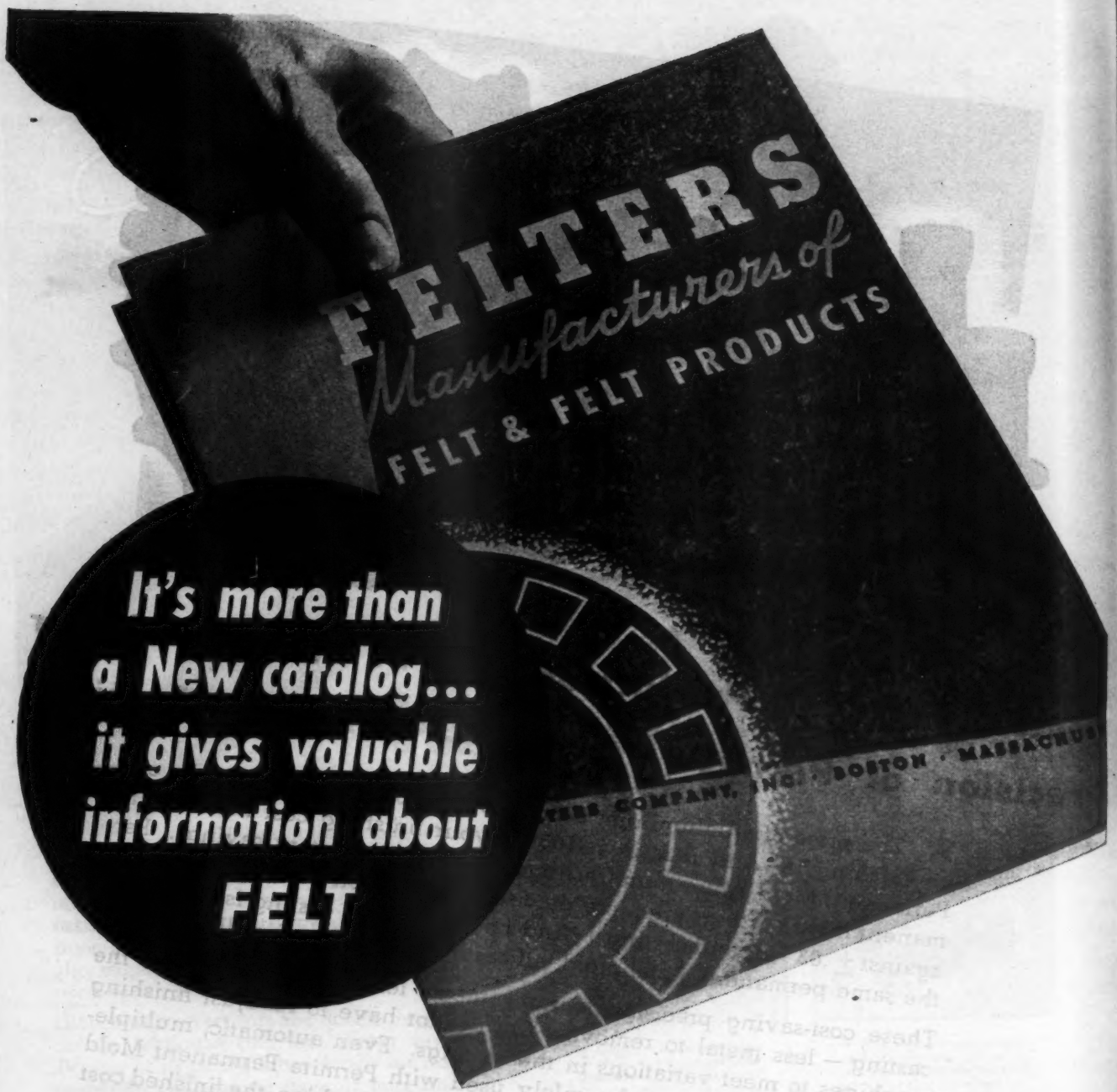
These cost-saving precision features mean less rough weight in the casting — less metal to remove. You do not have to readjust finishing machines to meet variations in the castings. Even automatic, multiple-operation machines can be safely used with Permite Permanent Mold Castings. You may also have fewer surfaces to machine; the finished cost per casting is often surprisingly low.

Aluminum Industries' first products — 25 years ago — were permanent mold aluminum castings. Today, no foundry is better equipped to turn out castings of this superior type. Experience has given us a thorough knowledge of aluminum and its alloys. And the specialized knowledge of our engineering staff is always at your service. We shall be glad to submit recommendations, upon request.

ALUMINUM INDUSTRIES, Inc.
CINCINNATI 25, OHIO

Detroit: 809 New Center Building
Los Angeles: 324 North San Pedro Street
Chicago: 616 South Michigan Avenue
New York: 9 Rockefeller Plaza

PERMITE ALUMINUM ALLOY CASTINGS



It's more than a New catalog... it gives valuable information about FELT

... Send for it today!

The new Felters Catalog gives you the fundamentals of felt functions . . . tells about the different grades and properties of felt . . . the *design* properties of felt . . . the acoustical and insulating qualities of felt . . . and a lot more important information. It is a ready reference . . . an easily understood "short course" in the various uses and applications of felt.

We shall be glad to send you your copy of this new catalog by return mail . . . and, also, if you wish, put your name on the list of those who receive Felters Engineering Bulletins. These bulletins periodically supply specific or timely data about Felters Felt in a way that may well help you in your work.

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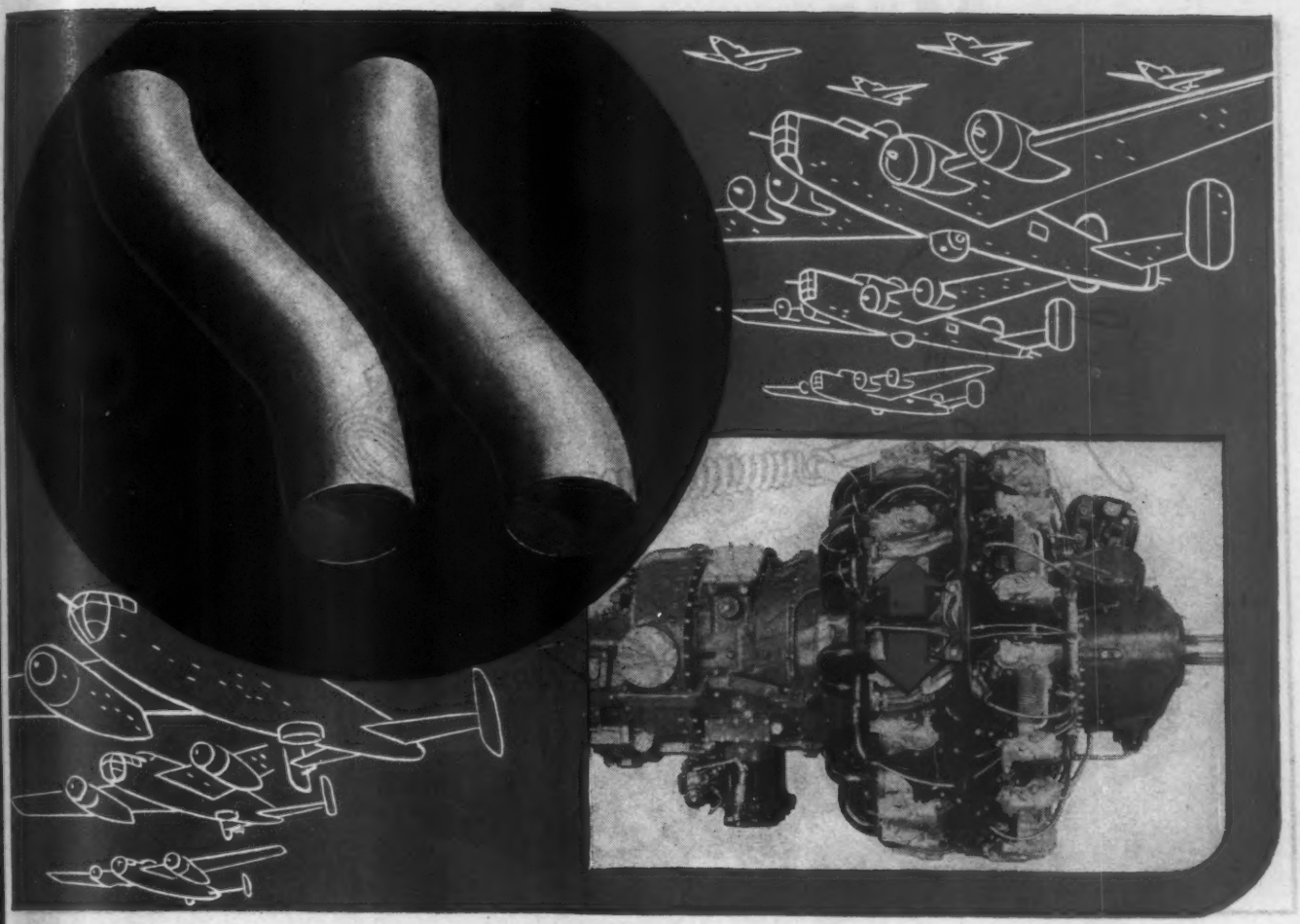

STAINLESS STEEL THROATS

for Fire-Spitting Dragons of The Skies

No legendary dragon ever excited more fear in its victims than our fighting aircraft are striking to the hearts of our enemies. To them our bombers and fighters have become fearsome dragons of the skies.

Propelling each of these airplanes through the air is one or more powerful engines, from whose cylinders rush hot, flaming, corrosive gases—spitting fire like the dragons of old.

Only a few materials—among them Enduro Stainless Steel—can withstand the attack of corrosion and oxidation under such conditions for any length of time.

That is why Republic ELECTRUNITE Stainless Steel Tubing made of Enduro is used for exhaust stacks on many aircraft engines. On the engine above, this tubing is further protected by an outer sheath, forming an air circulating space for cooling purposes.

ELECTRUNITE Stainless Steel Tubing provides all of the features of Enduro—corrosion- and heat-resistance, ease of cleaning, high strength, eye-appeal—plus the uniformity of diameter, wall thickness, concentricity, ductility and scale-free surface provided *CONSISTENTLY* by the ELECTRUNITE process.

It may be the very material you need to improve your product. Write us for detailed information.

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CARELESS TALK MAY COST LIVES.
BE CAREFUL IN DISCUSSING WAR INFORMATION

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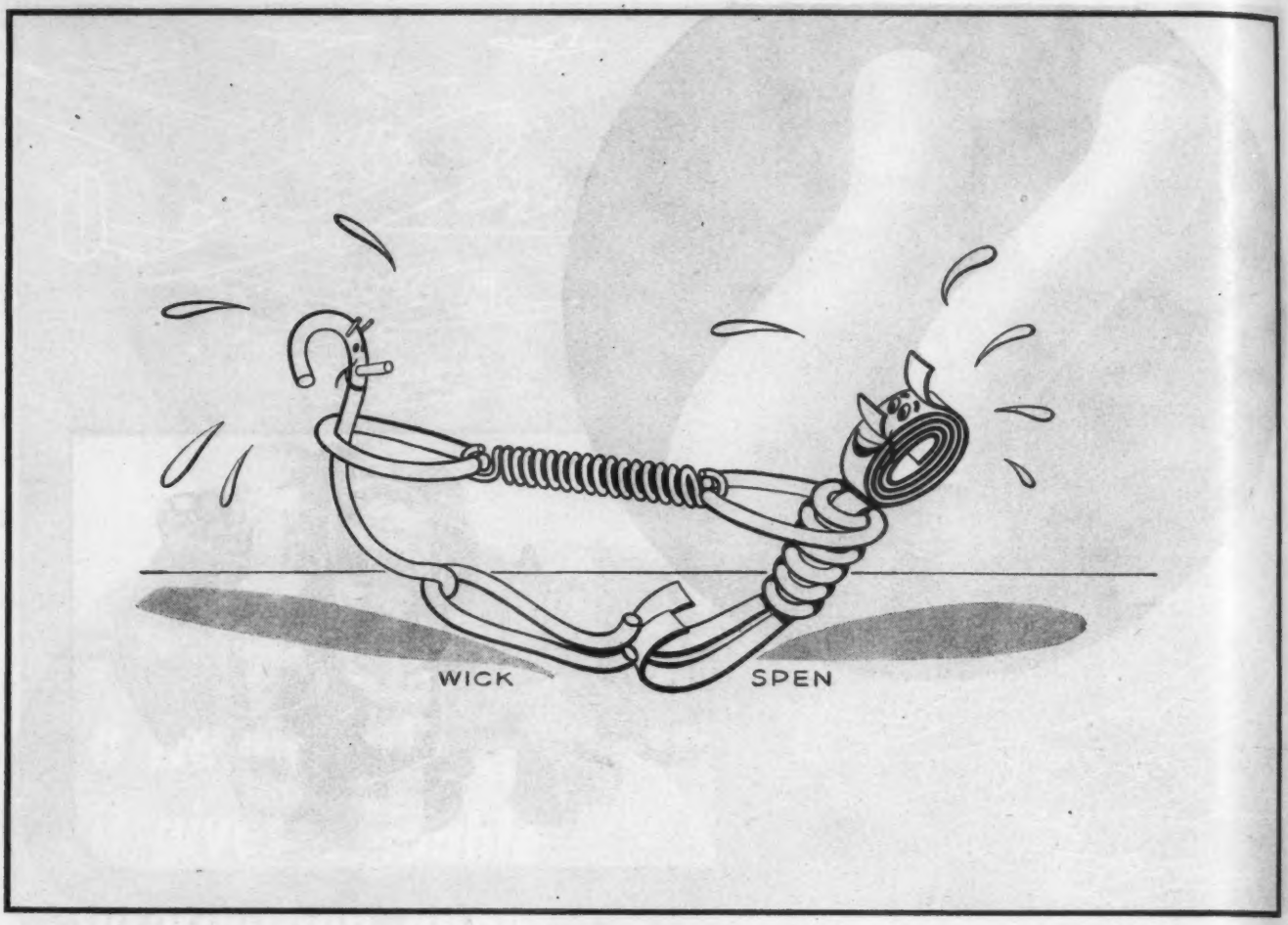
STAINLESS STEEL TUBING

Also Carbon Steel Mechanical Tubing — Aircraft Tubing — Boiler, Condenser and Heat Exchanger Tubes



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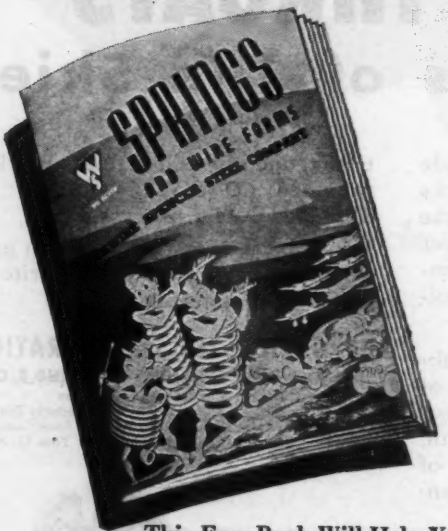

This Free Book Will Help You

Our book "Springs and Wire Forms" contains valuable technical information, formulae and tables relating to spring performance. Write today for your free copy. Spring Division, Wickwire Spencer Steel Company, New Bond Street, Worcester 3, Mass.

The dimensions of a spring are determined not only by load and deflection requirements, but by the elastic and fatigue limits of the material used in its manufacture. Establishing a proper relationship between these factors requires judgment based on engineering knowledge and experience.

Because our spring and formed wire specialists have had years of experience they are often called upon to help solve perplexing problems involving the use of springs. We engineer every conceivable type of spring, and, to insure top-flight performance, we make the steel in our own open hearths—draw, form, temper and test it in our own mills.

If you are planning a post-war product requiring springs or formed wires we will be happy to be of service. Wickwire Spencer Steel Company, Spring Division, General Sales Office and Plant, New Bond St., Worcester 3, Mass.

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FOR GOOD *Production* AND USE *Performance*...

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An important advantage of Red-X Alloys in the production of such critical parts as engine cylinder blocks, crankcases, and cylinder heads, is the fact that their carefully developed composition affords good castability. This results in greater freedom from defects, such as shrinkage porosity, cracks, and so-called cold shut or welds, and provides castings of desirable physical properties.

Used in automotive, marine, and railroad fields, as well as in armament for all branches of the Services, Red-X Alloys are noteworthy for uniformly satisfactory performance.

If you want Aluminum Alloys that will provide good production and use performance along with economy, inquire about Red-X Alloys—today.

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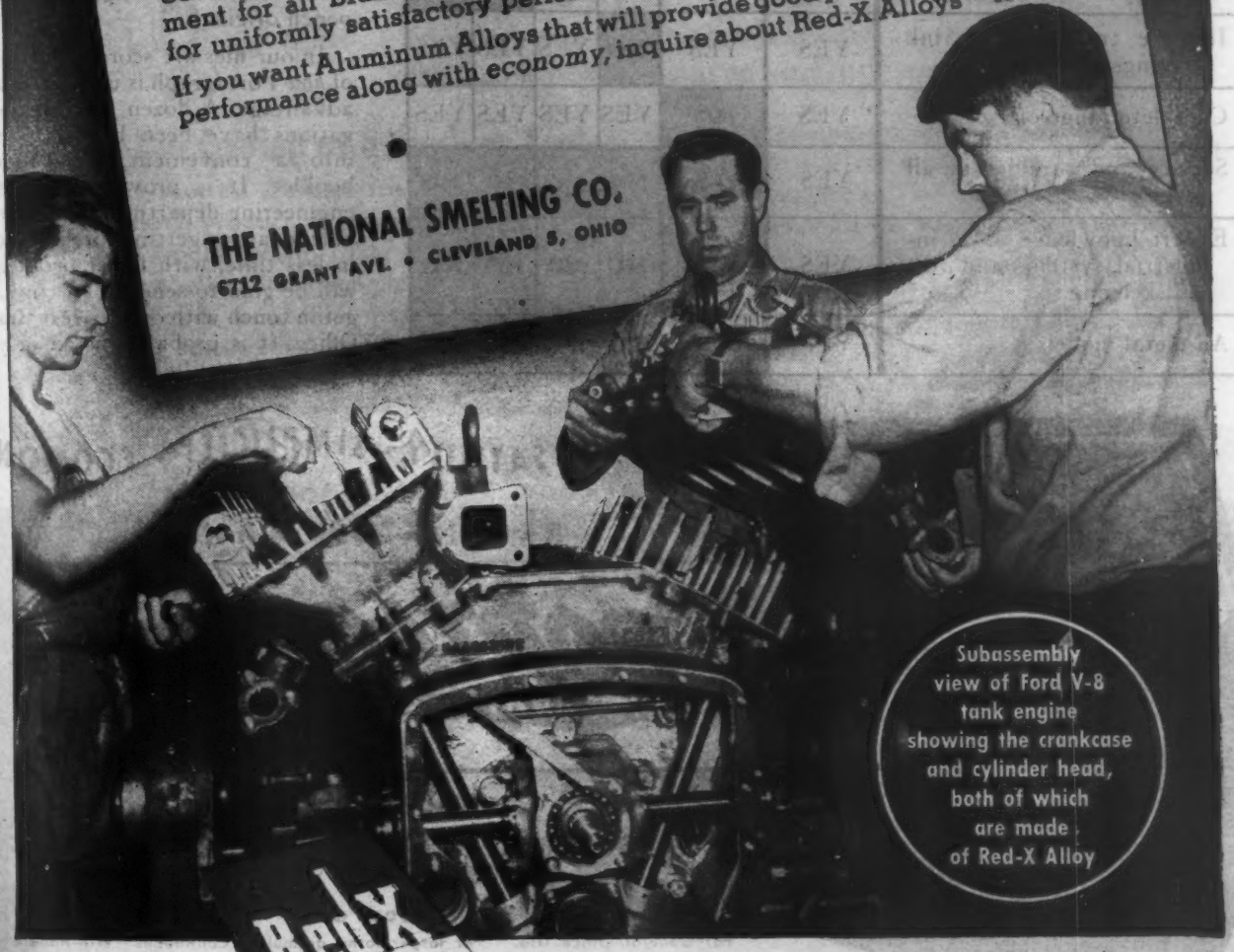
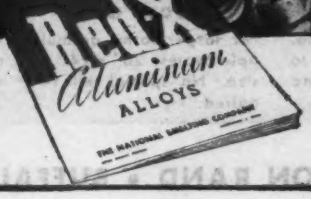


Subassembly view of Ford V-8 tank engine showing the crankcase and cylinder head, both of which are made of Red-X Alloy



Write For A Copy Of This Booklet

NATIONAL SMELTING

Looking for the best answer to **REPRODUCTIONS?**

REPRODUCTIONS —COMPETITIVE

DATA FOR ENGINEERING

FEATURES	PORTAGRAPH METHOD		OTHER PROCESSES			
	REMINGTON RAND	OTHERS	A	B	C	D
Confidential	YES	YES	YES	YES	NO	YES
Versatile	YES	YES	NO	NO	NO	NO
Working copies from other processes	YES	YES	NO	NO	NO	NO
Ink-like tracings from other processes	YES	YES	NO	NO	NO	NO
Good ink-like tracings from pencil tracings	YES	YES	YES	YES	NO	YES
Working paper copy from transparent tracings	YES	YES	YES	YES	NO	NO
Ink-like tracings from ink tracings	YES	YES	NO	YES	YES	YES
Complete range of sizes	YES	NO	YES	YES	YES	YES
Service and supplies in all large cities	YES	NO	NO	NO	NO	NO
Expert knowledge in *all* industrial systems and record keeping	YES	NO	NO	NO	NO	NO
All-metal models	YES	NO	NO	NO	NO	NO

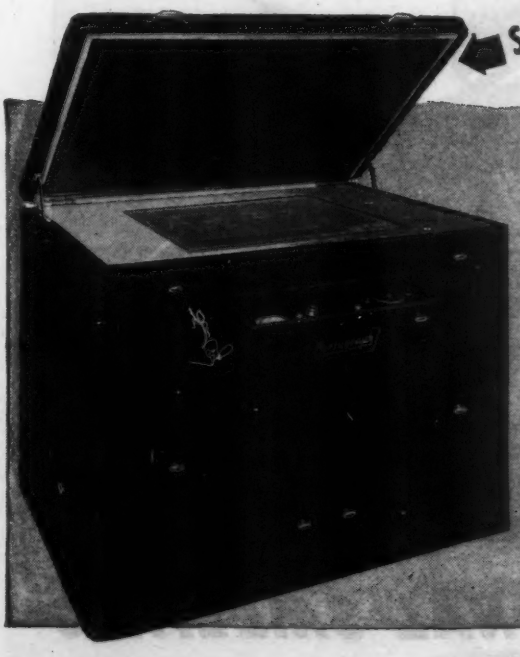
Part of the explanation for the popularity of Portagraph is given in the accompanying chart of Portagraph features. *As convincing as that is*, perhaps you would still like to read what users of Portagraph say.

SHIPYARD—"Even with inexperienced help we get faster and clearer copies of drawings and instructions."

STEEL COMPANY—"We're saving four to five hours per day on revisions alone."

TOOL MANUFACTURER—"We'd be 'sunk' without Portagraph. We're getting tracings which are much clearer and brighter than our pencil originals."

In our files are scores of examples of *how* Portagraph is used to unusual advantage. A dozen special investigations have been bound together into a convenient, cross-indexed booklet. It is providing plenty of engineering departments with workable ideas for getting lots more done in less time, with fewer people. We will be glad to send you a copy. Or, get in touch with our nearest Branch Office; it is probably listed in your phone book.



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REMINGTON RAND

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Vacuum Seal—Made in 30" x 40" or 40" x 60" size. Ideal for engineering drawings, etc.

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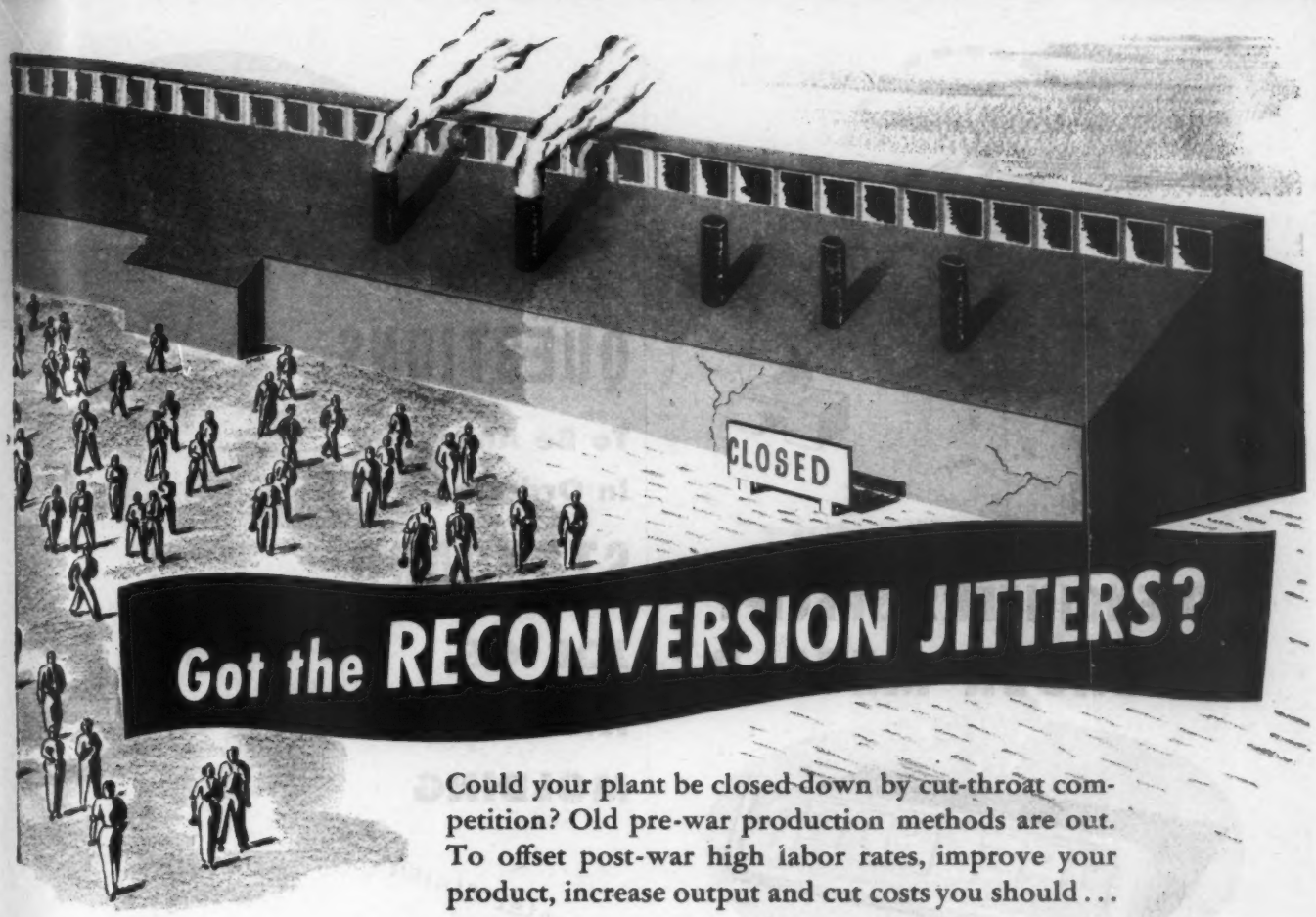


Got the RECONVERSION JITTERS?

Could your plant be closed down by cut-throat competition? Old pre-war production methods are out. To offset post-war high labor rates, improve your product, increase output and cut costs you should . . .

Use Die Casting as a Machine Tool

As the shortest distance from raw material to finished product, die casting . . . when used as you would use any other machine tool . . . offers unbelievable economies in all types of metal goods fabrication. Based on the outstanding advancements made during the war, "Red" Harvill now offers his "Complete Die Casting Package Plan" . . . a production plan which is a sure cure for reconversion jitters.

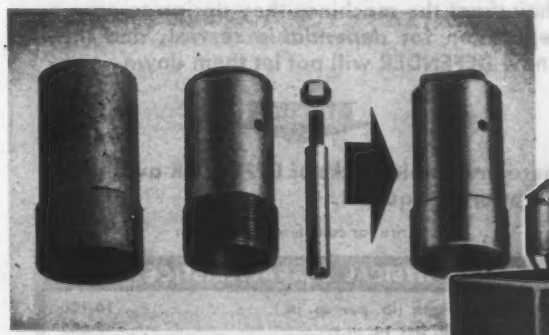
See RED and be ready

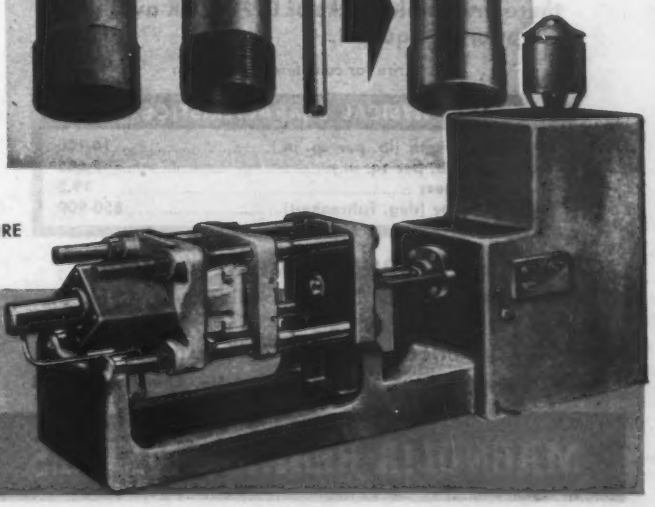
Start now to plan your post-war production, but be sure your plans will make you competitive in your post-war markets. Discuss unlimited possibilities of die casting your product with "Red" Harvill now and be ready for reconversion.

Die casting equipment as a tool in your production line will cut costs, increase output, reduce investment and inventories. Write for descriptive catalog on your firm letterhead.

Die Casting Saved 75%

Case History No. 103. Conversion to die casting eliminated all machine operations except threading O. D., eliminated through-bolt spring guide. Costs cut 75% on 50,000 pieces.





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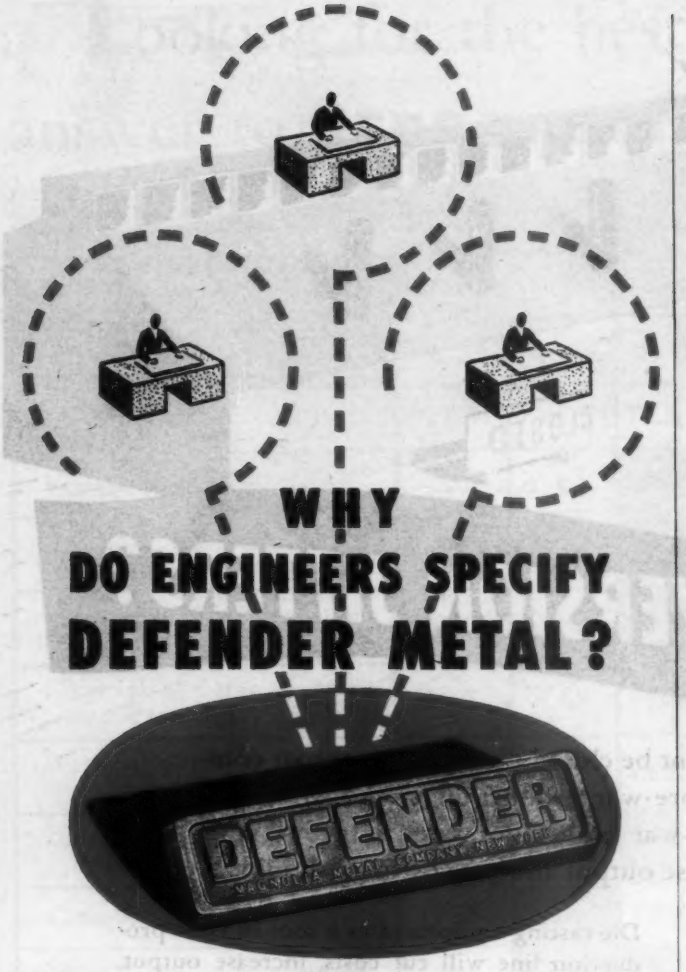

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they know DEFENDER METAL has been alloyed especially for malleability, strength and toughness. That it withstands shock loads . . . hammer-blow strains . . . *without cracking or chipping.*

BECAUSE

they want the machines they design to earn a reputation for *dependable service,* and they know DEFENDER will not let them down.

BECAUSE

there are ample stocks of DEFENDER available. No priority required.

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Ultimate Strength (lb. per sq. in.)	16,100
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Brinell Hardness	19.5
Pouring Range (deg. Fahrenheit)	850-900

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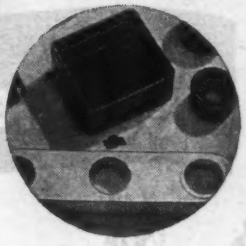
To Be Answered In Ordering a

STANDARD

JOB OF INJECTION MOLDING



Special finish?
Materials?
Number of die cavities?
Work from sample?
Expected annual requirements?
Maximum and minimum temperature encountered?
Colors?
Finish?
Regular finish?
How ship?
Tool cost?
Work from blueprint?
Bulk?
Individual pack?

If you are approaching the point where you are interested in estimates on injection molded products, give us the answers to the above questions for quotation.

THE Standard MOLDING CORPORATION
DAYTON 1, OHIO

PRODUCTION DESIGN SERVICE

Superiority of PANELYTE*

SHOWN IN HARTZITE FAN BLADES

PANELYTE Blades in five Hartzite Fans, as above, in operation since June, 1942, unaffected by atmospheric change or corrosive attack.

PANELYTE Blade (62" long — 14½" across widest section), mass-produced for Hartzell Propeller Fan Co., Piqua, Ohio, being removed from mold . . . one of the largest thermo-setting plastic parts ever produced commercially.

In Corrosion Resistance . . . Light-Weight Strength . . . Long Trouble-Free Service

Since June, 1942, 30 PANELYTE Plastic Fan Blades have been in operation atop a midwest municipal works — without developing corrosion spots or other defects! Outdistancing performance of aluminum or metal-sheathed wood, light-weight PANELYTE (specific gravity only one-half that of aluminum) cuts equipment costs by permitting low starting current urge and, by lessening bearing loads.

Low coefficient of friction prevents roughening of blade surface, while greater internal damping reduces noise. Precision molding makes blades interchangeable . . . saves production time and expense.

PANELYTE engineers are ready to work with you in the application of paper, fabric, wood veneer, fibre glass and asbestos base thermo-setting laminated plastics, and to discuss the mass production of intricate fabricated and molded parts.

Write for factual "Data Book"

PANELYTE *the structural plastic*

PANELYTE DIVISION
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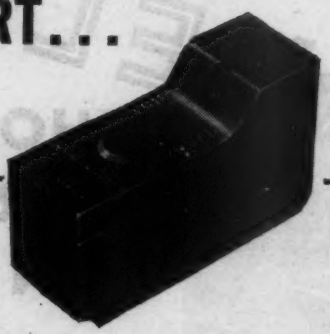
MASS PRODUCTION OF SHEETS, RODS, TUBES, MOLDED FORMS, FABRICATED PARTS

The sixteenth in Aico's plastics applications series.

COLD MOLDED PLASTICS have a PART...

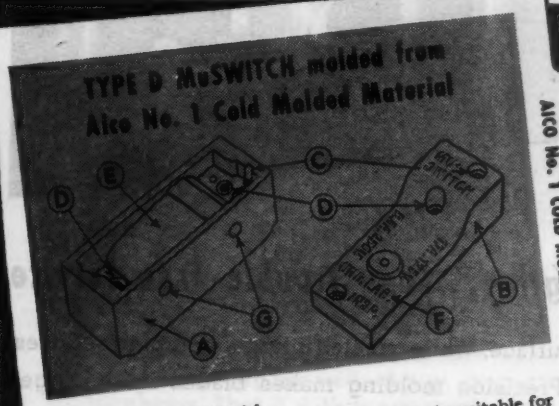
IN BOMBING THE ENEMY!



AICO'S fast cold molding process helps to do some of the "stepping up" in America's new stepped up multi-bomber program.

The case for this Type D MuSwitch, used in the Army's giant B-29 bomber, is molded rapidly and economically at Aico. Bases and covers are produced at a rate of several thousand per week.

Aico cold molded plastics have excellent properties for electrical parts applications. Aico's 29 years of experience is a guarantee of expert plastics engineering.



MOLDING MATERIAL

Aico No. 1 cold molded material is particularly suitable for use in electrical parts. It has high heat resistance (will withstand temperatures up to 600° F.), low heat conductivity, and assures freedom from arcing. Plastic materials offer the additional advantage of light weight—important in aircraft parts.

MOLD DESIGN

A single cavity mold was designed for each of the two parts of this switch case—base (A) and cover (B). Design for the base includes holes (C) for assembly. Threaded metal inserts (D) are molded in, demanding extreme accuracy in the mold design. Corresponding design features are provided in cover (B) as indicated at points C and D. Note indentions and planes (E) of interior surface designed to hold interior mechanism firmly in place. Embossed lettering (F) is confined to flat surfaces.

MOLDING METHOD

The cold molding method permits high production at a low mold investment, producing durable and accurately molded parts speedily and economically.

FINISHING

Finishing operations on the Type D MuSwitch consist of drilling mounting holes (G) in base, brushing and tapping inserts, and grinding joining surfaces of base cover.

Write on your business letterhead for additional copies of Aico file cards Nos. 1 to 15.

AICO

Aico PRECISION MOLDING

29th Year

AMERICAN INSULATOR CORPORATION, New Freedom, Pa.

Sales Offices: BOSTON · BRIDGEPORT · BUFFALO
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A MIGHTY MITE is he!

RED-HEADED RUBBER FUSE BLOCK

MADE BY JOHNSON

This wee bit of a redhead is our engineer's answer to another rubber problem—it is a rubber fuse block for Littlefuse Incorporated and a very important part of a plane. • Starting out as a regular piece of rubber, it acquires a bright red head, a head that is actually the same piece of rubber as its black body and will not fade or detach from it. • It holds two fuses, one on each end. When installed in a plane, the red end is inserted first, leaving the other end exposed to view. When number one fuse is burnt out, the pilot reverses the ends, thereby obtaining a new fuse, then the red end is exposed to view. • When plane lands this fuse block speaks for itself for the red end, a warning signal, indicates to all mechanics that a fuse is burnt out on the ship and needs a replacement. • It not only functions as a danger signal but carefully cushions the fuses, protecting them and absorbing the vibrations.

If you have a problem, let us have it; we welcome the difficult ones.

JOHNSON RUBBER CO.

Middlefield, Ohio U.S.A.

When it's FIRE EXTINGUISHERS *instead of Flame Throwers*

Strict adherence to specifications for brass and other copper-base alloys produced by Western has enabled manufacturers to meet more successfully the problems of producing war materials. Our years of experience enabled us to meet these important requirements.

When the flames of war have burned out and attention is again turned to peacetime products, Western metals will be available in stamped parts, sheet, strip and long coils. New designs . . . possibly in fire extinguishers, as well as hundreds of other products . . . will require the workability, ageless beauty and long life of copper and related alloys.

The skill and facilities of Western's mills at East Alton, Ill. and New Haven, Conn., are at the disposal of all who work with metals or combine metal parts with non-metallic substances. We'll do our utmost to serve you well . . . now, or in the months to come.

Western BRASS PRODUCTS

Western BRASS MILLS

Division of WESTERN CARTRIDGE COMPANY, *East Alton, Ill.*

BRASS • BRONZE • PHOSPHOR BRONZE • NICKEL SILVER • COPPER

TO BUYERS OF CASTINGS

*Aluminum and Zinc

FOR *Absolute Dependability*

IN DESIGN · PRODUCTION · PRICE AND DELIVERY · Check ✓ MONARCH

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Monarch offers you 31 years' experience, including two years of war-intensive application to rigid specifications . . . experimenting with new alloys . . . developing new techniques.

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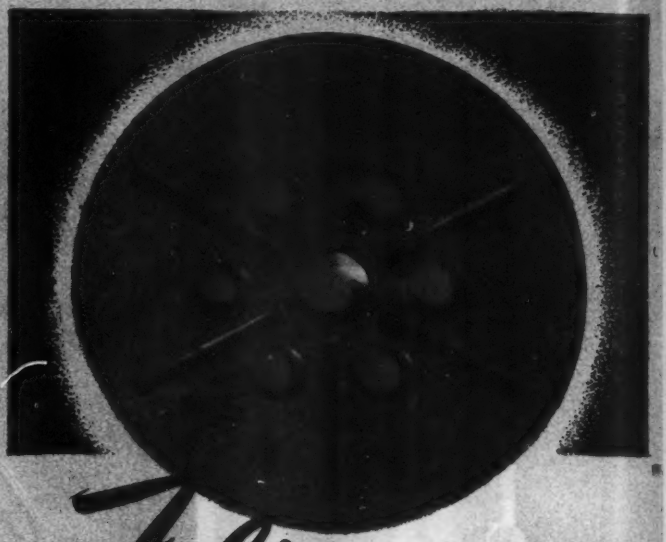

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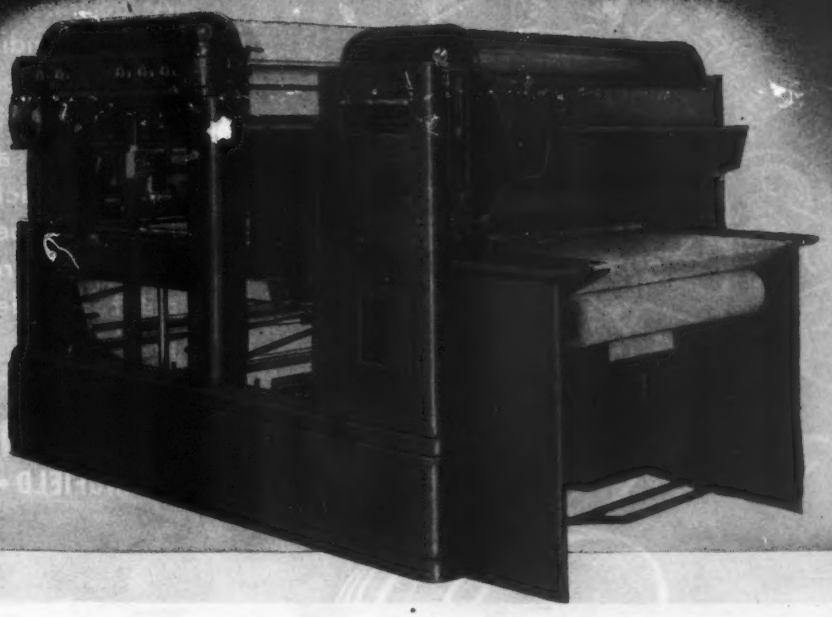

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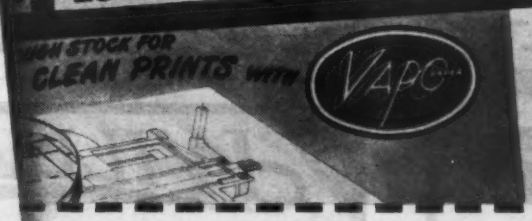

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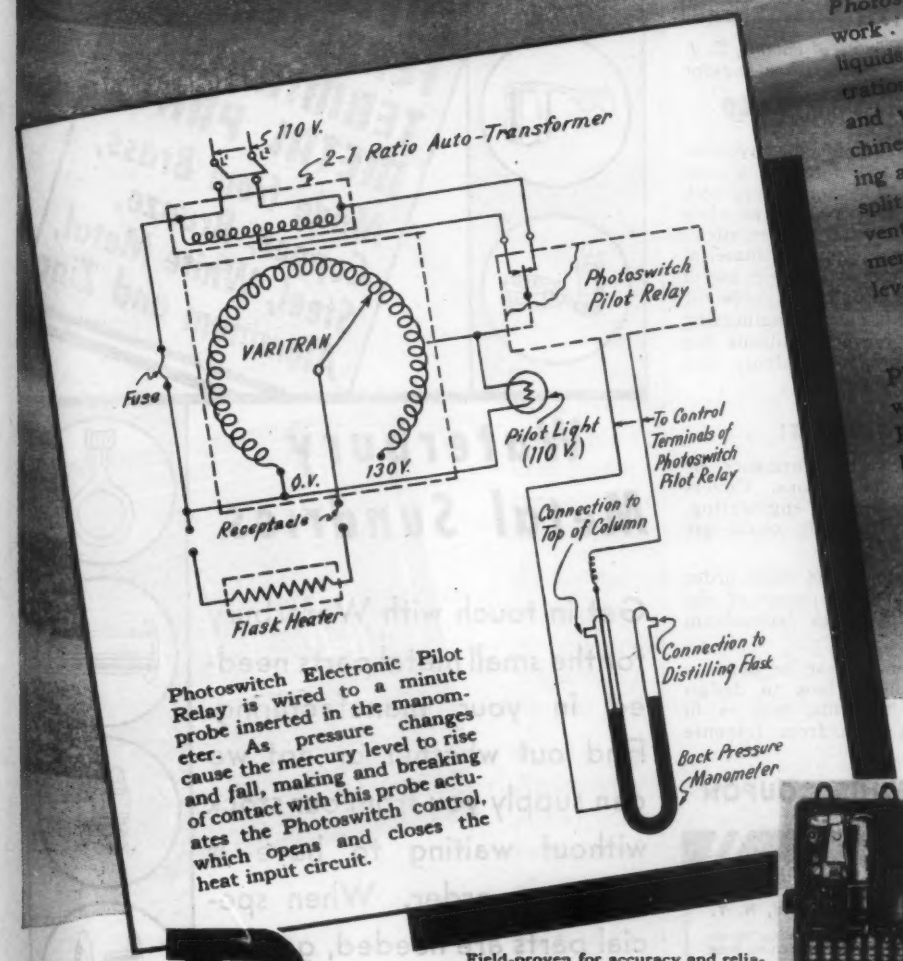

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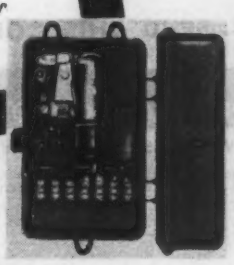

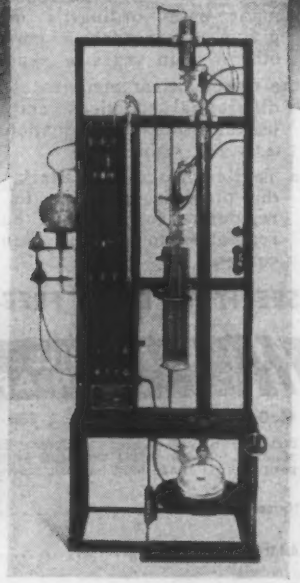

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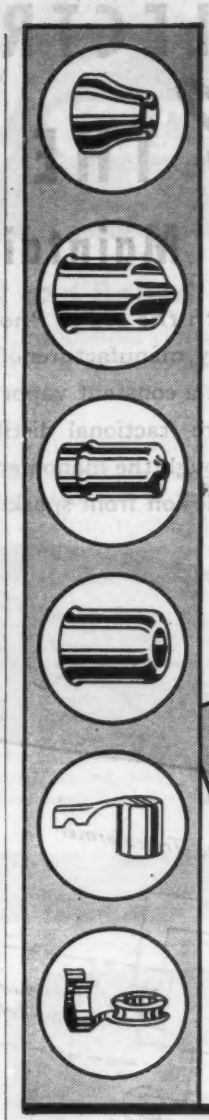

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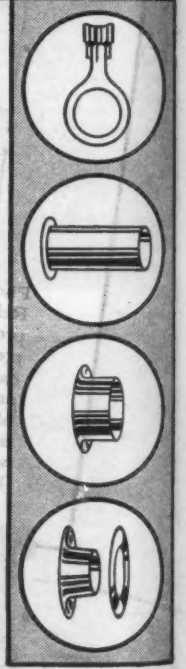

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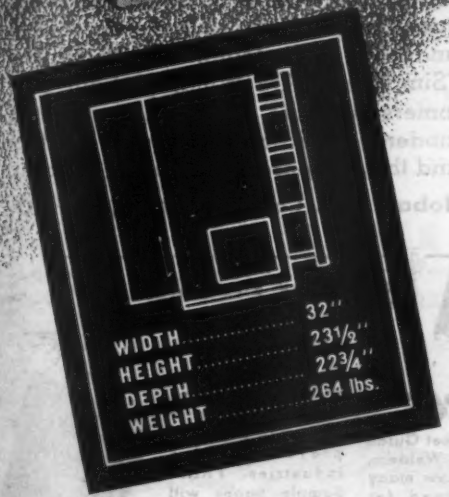

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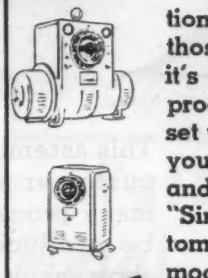

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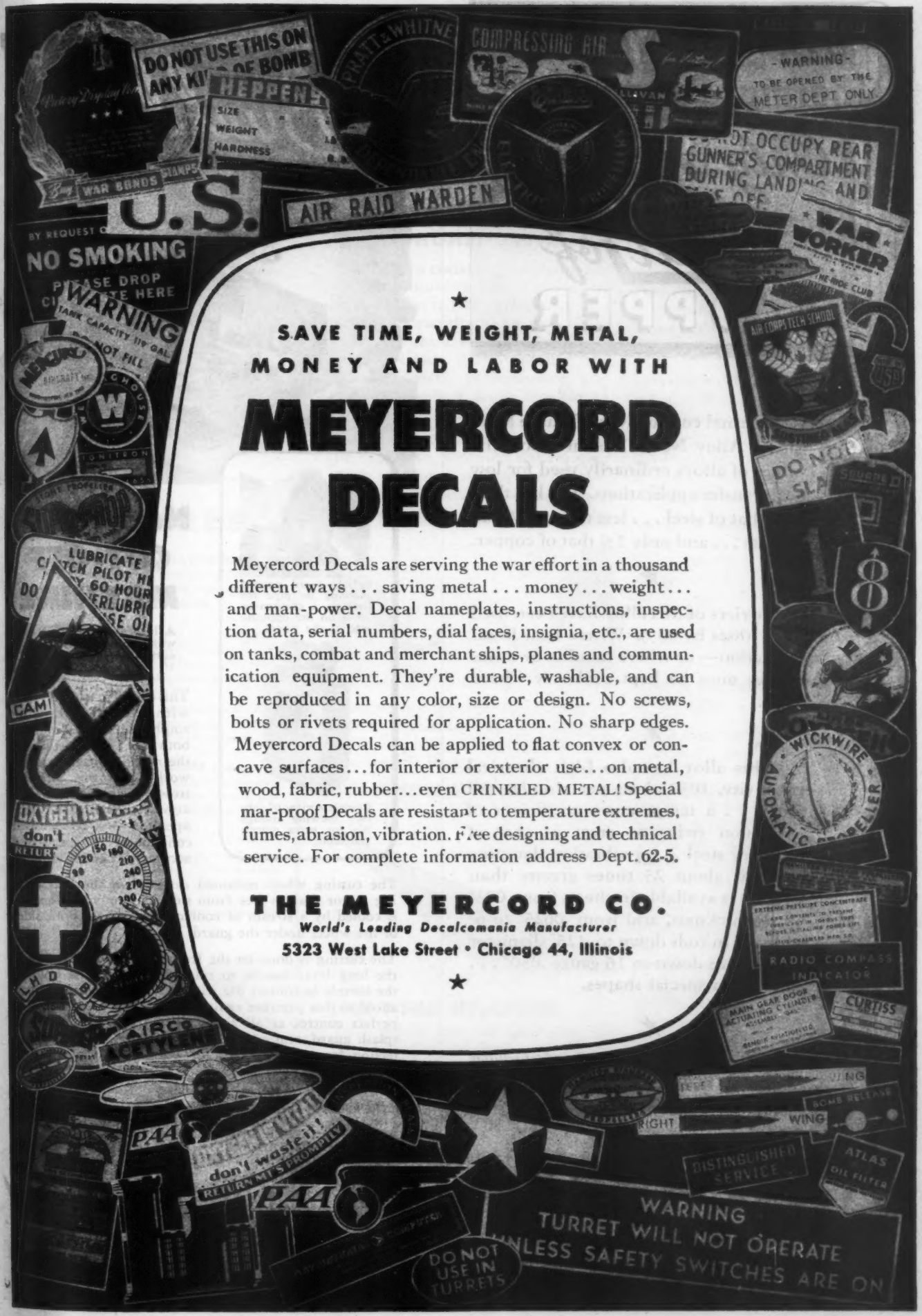

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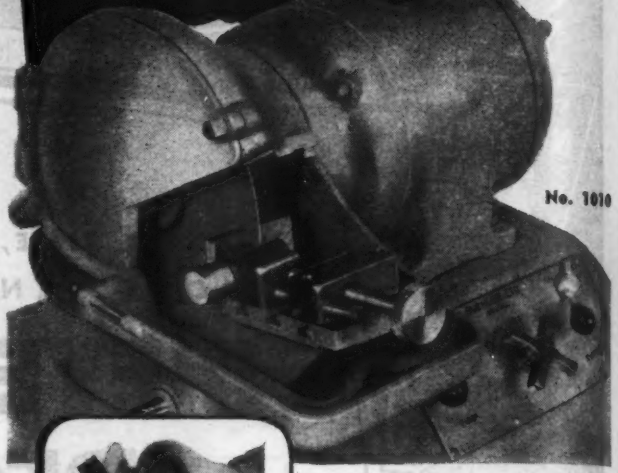

No. 1010

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This efficiency is made possible by the exclusive, patented Barnes gear tooth structure, together with precision methods of manufacturing. Few pumps could be more simple in design and operation. No pump can operate with less wear and need for maintenance.

Investigate the possibilities of using the Barnes *Constant-flo* Rotary Gear Pump to obtain better performance in the equipment you manufacture. Our engineers will be happy to work with you.

FEATURES

1. EFFICIENT FLUID DISPLACEMENT. Precision manufacture maintains at an absolute minimum, variations due to viscosity and slippage. Pump is self-priming.

2. NEGLIGIBLE AERATION. (due to vacuum action) because each tooth completely fills mating space in patented Barnes gear tooth structure. Precision machining throughout.

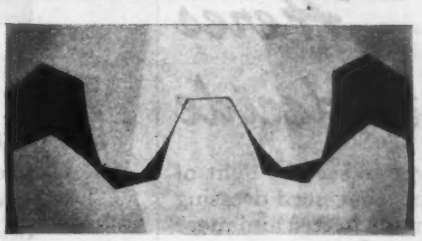
3. NEGLIGIBLE WEAR because teeth mesh in a rolling action, eliminating excessive sliding. Pump has only 2 moving parts.

4. NEGLIGIBLE MAINTENANCE because no external means of lubrication and no separate bearings are required. Simple construction makes it possible to take the pump apart and reassemble it in a jiffy.

5. CONVENIENCE — Pump is small, compact — weighs only 3½ lbs. Can be mounted in any location convenient to power take-off.

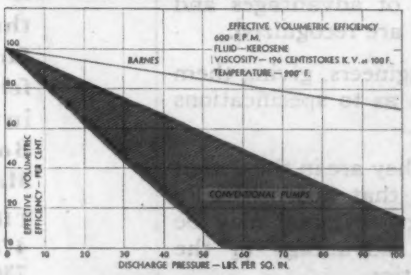
6. PUMP DELIVERY — To 350 gallons per hour at 3600 R. P. M.

NOTE THIS GEAR TOOTH STRUCTURE



Two sturdy spur gears rotating inside a housing provide efficient fluid displacement in the Barnes *Constant-flo* Pump.

NEW PUMPING EFFICIENCY



SOME TYPICAL APPLICATIONS

This pump can be used for all liquids having lubricating qualities. It makes an excellent fuel pump for industrial oil burners and other similar applications. It is an important part of a highly efficient torque converter. It can be used as a lubricating booster pump for oil lines, as a gasoline dispensing pump, and for oil pressure systems on all types of internal combustion engines. The latter suggests its usefulness in heavy automotive equipment — trucks, tractors, etc.

TEST IT ON YOUR EQUIPMENT AT NO COST

We'd like to place one of these pumps in your plant — on your product — so that you can check and compare to your own satisfaction. To any bonafide manufacturer of equipment using a fluid pump, we will ship for trial purposes a new Barnes *Constant-flo* Rotary Gear Pump.

Test it on your present and experimental equipment! Put it up against the very best pump you've ever purchased and compare efficiency and performance . . . compare simplicity . . . compare convenience of size, weight and construction.

If you are interested in convincing yourself of Barnes pump superiority, write Department LL, describing your problem, fluid capacity, pressure, pump speed required, etc.

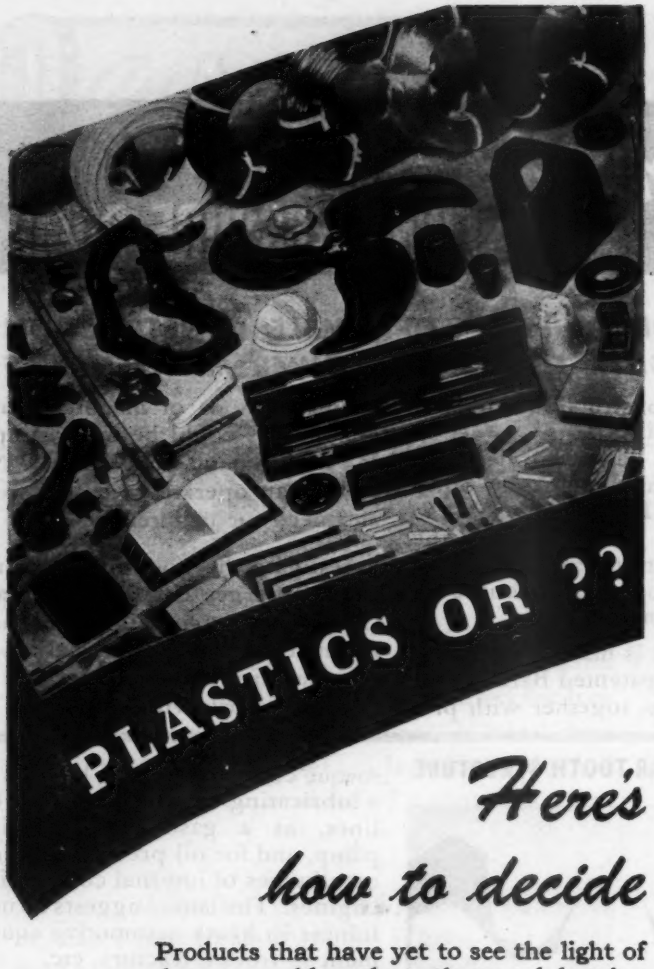
FOR PUMPING FLUIDS LIKE THESE:

Fuel Oils, Gasoline, Benzine, Naphtha, Kerosene, Olive Oil, Mineral Oil, Hot Oils, Hot Lard, Cocoanut Oil, Cottonseed Oil, Hydraulic Oil, Vegetable Oils, Lubricating Oils, Quenching Oils, Linseed Oil, Torque Converter Fluid and many others.

FREE DATA

Get complete information on the Barnes *Constant-flo Pump*—write now for a copy of this free illustrated bulletin. Gives specifications and capacities, also makes suggestions as to how you can put this efficient new pump to work for better performance of your equipment. Ask for Bulletin PC1244.

John S. Barnes Corporation ROCKFORD, ILLINOIS



Here's how to decide

Products that have yet to see the light of day . . . or old products that need dressing up . . . often may be made better and more economically by means of plastics . . . but not always!

How to decide what material to use becomes a problem for experts.

Choose a molder for consultation whose experience and knowledge of advantages and limitations of plastics are recognized.

Consult with that molder's engineers, giving them complete information as to specifications and conditions of use.

Discuss your problems while they are in the design stage. Often a design that was originally dictated by limitations of metal may be altered to take full advantage of the characteristics of plastics.

Facilities for molding small parts automatically and at low cost, are offered by our associate, The Woodruff Company, Auburn, New York.

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ALL TYPES OF MOLDING COMPLETE MOLD SHOP
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Almost any desired combination of qualities . . . durability is only one . . . are obtainable through the *controlled* manufacture of Booth "prescription" felts and precision die-cutting into mechanical parts. Read Booth's "Technique of Felt Making."

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APPLICATION CHART AND SAMPLE KIT . . . Contains swatches of S.A.E. felt types, with specification tables. Write for it. (No sales follow-up.)

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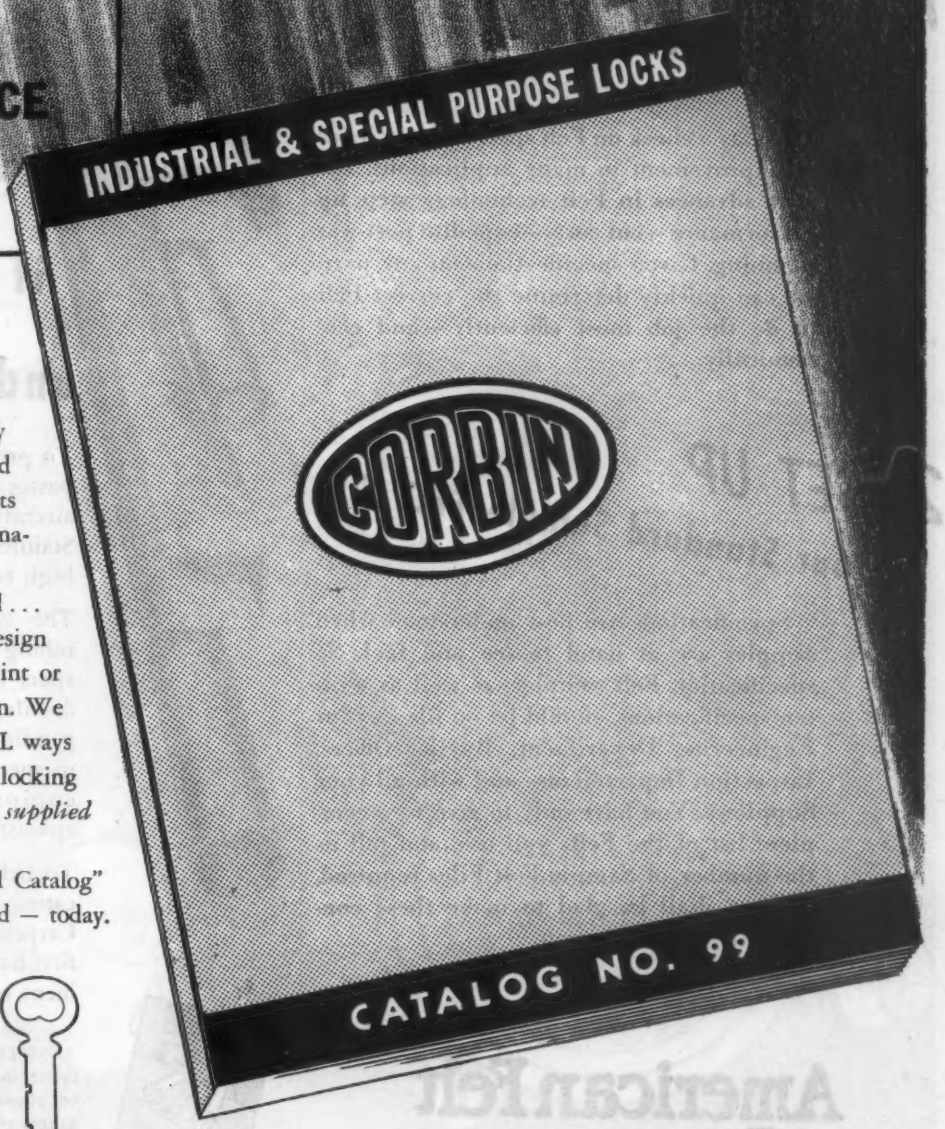
TRADE MARK

PRECISION CUT FELT PARTS

For Speedier Design Jobs

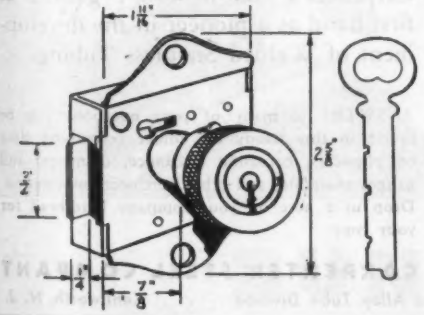
100 PAGES OF LOCKING DEVICE "KNOW HOW"



Concise and indexed for speedy reference, the Corbin "Industrial Catalog" is a handy help when a quality stock locking device is needed — and needed FAST! It is not a treatise. Its purpose is to supply "finger-tip information" when time is short.

When original designs are involved . . . or installation is a problem . . . many design engineers prefer to mail us a blueprint or have a Corbin Lock engineer drop in. We have worked in each way and in ALL ways for over 62 years to the end that better locking devices may be *conceived, produced, supplied* and *installed.*

If you do not have this "Industrial Catalog" please write for it, on your letterhead — today.



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American Felt Company

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Sales Offices at: New York; Boston; Chicago; Detroit; Philadelphia; Cleveland; St. Louis; San Francisco; Dallas; Seattle; Los Angeles

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it gets HOT under the collar

To protect the exhaust stack where it passes through the firewall of this aircraft assembly, Carpenter Welded Stainless Tubing was selected for its high resistance to excessive heat.

The *uniform wall thickness* of this tubing means that there are no thin spots to "burn out" first. And it is ductile, easy to form by bending, expanding, flanging, etc.—thus helping to speed production of vitally needed equipment that must win battles against high temperatures.

To lick your tough design and fabricating problems, take advantage of Carpenter's "know how", gained at first hand as a pioneer in the development of Welded Stainless Tubing.

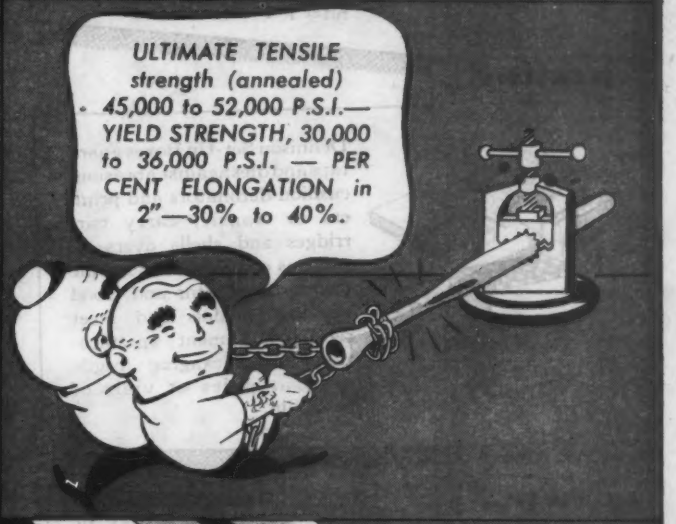
ANSWERS to many of your questions can be found in this handy file folder containing data on physicals, corrosion resistance, diameters and gauges available, and other pertinent information. Drop us a note on your company letterhead for your copy.

THE CARPENTER STEEL COMPANY

Welded Alloy Tube Division . . . Kenilworth, N. J.

Carpenter WELDED STAINLESS TUBING

BUNDYWELD can take it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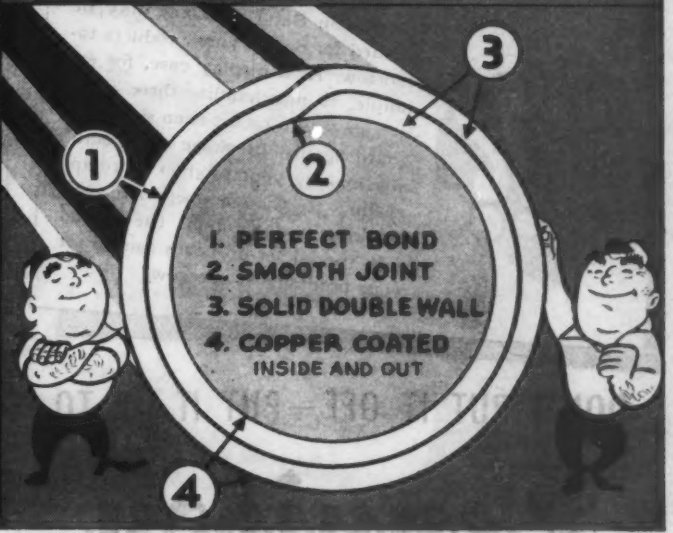

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YOU plan that Postwar Product...
Let **DENNISON** plan the Set-Up-Box

PREWAR...

Dennison Set-Up Boxes provided glamorous settings for cosmetics and perfumes; highlighted as gifts such specialties as leather billfolds, belt buckles and fountain pens; made showcase pieces of clinical thermometers—and solved packaging problems for nipples, vitamin capsules and filter paper.

WARTIME...

Dennison Set-Up Boxes guard taps and dies against abrasion; cushion detonators and primers in transit; carry cartridges and shells overseas; serve as containers for Purple Heart, Silver Star and Good Conduct medals and meet rigid government specifications for packaging fragile drug ampules or vials of penicillin.

POSTWAR...

Dennison Set-Up Boxes may be needed for one of your products tomorrow. As a display case, for example, to merchandise three products as a unit, rather than singly; to guard against breakage while actually making your product more appealing to the shopper. Are you thinking, today, about the special jobs special set-up boxes can do for your products—tomorrow?

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Dennison experience and facilities have been multiplied and broadened by hundreds of specialized problems presented by war. Let Dennison plan today the set-up box that can be manufactured tomorrow. Write Dennison Manufacturing Company, 47 Ford Avenue, Framingham, Mass.

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● Many component parts of your post-war products can be made better, faster, cheaper—with OH-38.

OH-38 Aluminum Alloy—Non-Heat Treated—an exclusive product of Hedstrom—is a perfected metal with proven superiority in a wide range of machining operations.

Easily machinable—easy on tools—increases tooling accuracy—holds threads without stripping. Non-corrosive—non-oxidizing—non-magnetic—spark-proof—does not require heat treatment—will not expand or contract. Tensile strength: 35,000 to 40,000 lbs. per square inch. Polishes to silver mirror brilliancy—takes chrome, nickel, or tin plating—may be annodized. Has many other manufacturing advantages.

OH-38 is used only in castings by Hedstrom. Our Pattern Service will supply complete models of parts for your new products. Send for technical information.

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for PRIORITY and NON-PRIORITY USES

Wrinkle finishes are being used successfully today in many fields of production. They provide a tough, durable coating, and bake out to the characteristic wrinkle pattern. A single coat, using ordinary methods of application, will hide imperfections in the raw metal.

Our Victory Wrinkle synthetic enamels are made in two grades — one for priority and one for non-priority uses. For further information on these products, send for the technical bulletin, "Victory Wrinkle Enamels."

Formula for a quick "Finish"
Buy more WAR BONDS

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YOU plan that Postwar Product...
Let **DENNISON** plan the Set-Up-Box

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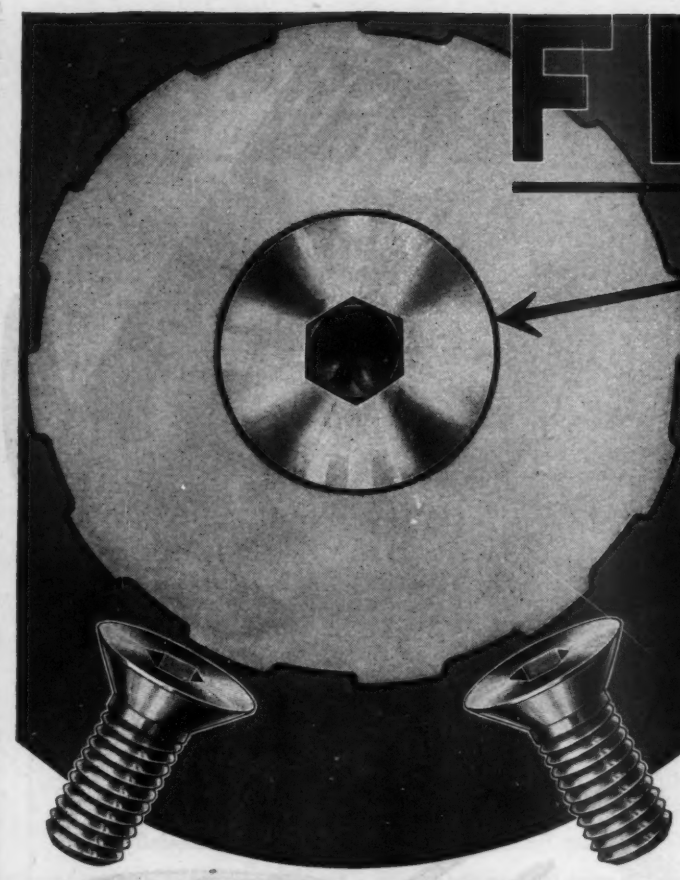

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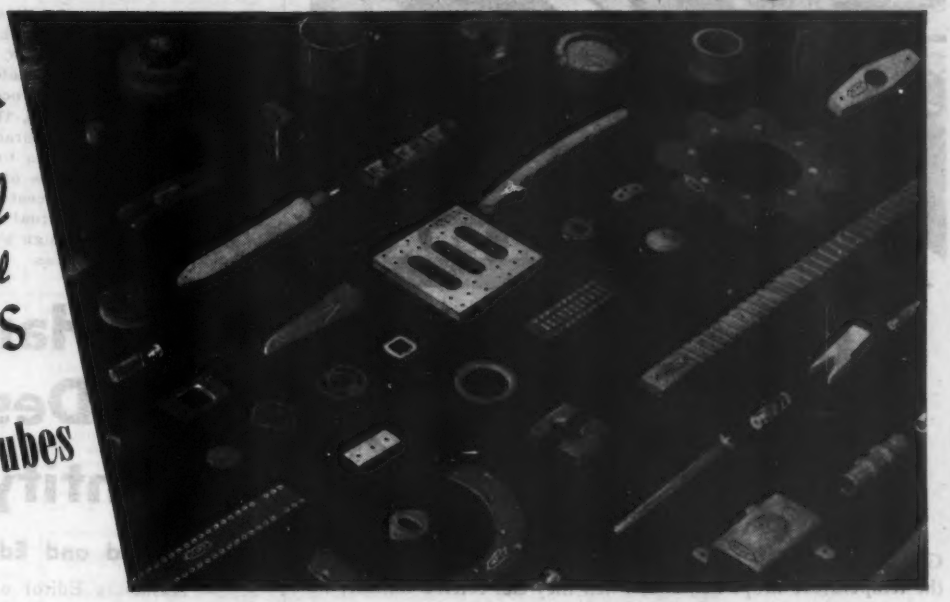

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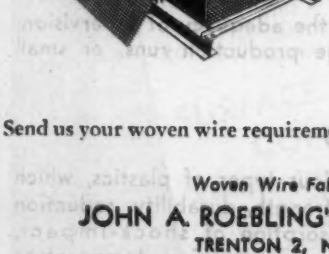
Roebling Woven Wire Cloth is *another* result of 100 years of *wire specialization.* From wire screen of 325 mesh made of .001" diameter wire to 6" openings of 1" rod—*in any metal*—you benefit from this *know-how* when you specify "Roebling"!



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in designing basic parts for quantity production

Written by seven authorities, this book gives a completely practical treatment of the design of basic parts for quantity production by die casting, sand casting, screw machine, stamping, die forging, hot and cold heading and plastic molding. Along with full explanations of the various high-production processes and sound pointers on designing for each one of the processes, the book gives many specific rules, amply illustrated to show their practical applications, for designing products that will lend themselves to rapid and economical mass production. In Part II various types of products manufactured in quantities at moderate or minimum cost are compared, one against the other, in many instances with actual production costs and tabular comparisons, to show the type of design best adapted to economical manufacture in various specific instances.

Handbook on Designing for Quantity Production

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4. Design of Stampings
5. Design of Die-forged Parts for Quantity Production
6. Notes on and Accomplishments in Hot Heading
7. Notes on the Design of Cold-headed Parts
8. Design of Plastic Moldings for Economical Quantity Production
9. Die Cast or Sand Cast?
10. Permanent-mold and Die Castings Compared
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WANTED: MECHANICAL engineers for permanent positions in East with established company. Experience in designing corrugated and fibre shipping container machinery desirable. Give complete details as to present work, education, experience, age, draft status, family, salary expected. All replies held confidential. P-814, Product Engineering, 330 W. 42nd St., New York 18, N. Y.

LARGE SOUTHERN aircraft company has position offering excellent post-war future for senior tool designer with four to ten years aircraft or light metal background, experienced in designing main fixtures and jigs. Should be capable of tool planning and group leadership. College education or equivalent desirable. Employment Manager, Bechtel-McCone Corporation, Birmingham, Alabama.

ENGINEERS, MECHANICAL draftsmen and detailers. Midwest manufacturer desires several engineers, mechanical draftsmen and detailers with heavy or excavating machinery experience for design and detail work leading to permanent engineering positions with responsibilities. Excellent post-war opportunity. WMC rules apply. P-824, Product Engineering, 520 N. Michigan Ave., Chicago 11, Ill.

MACHINERY DESIGN Engineer — Preferably with experience in the designing of automatic packing and wrapping equipment. This position has excellent post-war prospects, because it ties in with our expansion plans now under way. Excellent salary for an engineer with the proper qualifications. The Girdler Corporation, 223 East Broadway, Louisville, Kentucky.

GRADUATE ENGINEER experienced on stamped sheet metal products to serve as executive assistant to Chief Engineer. Job requires knowledge of materials, dies, fixtures, listing of products, engineering organization, product development and executive ability. Excellent opportunity to the right man both now and post-war. Company normally makes domestic electrical appliances. P-845, Product Engineering, 520 N. Michigan Ave., Chicago 11, Ill.

MASTER MECHANIC to develop and supervise manufacturing processes, tool and die department, fixture design, arc, gas and resistance welding equipment etc. with company manufacturing stamped sheet metal products. Job requires experience plus executive ability. Very interesting work with excellent opportunities both now and post-war. Company normally makes domestic electrical appliances. P-846, Product Engineering, 520 N. Michigan Ave., Chicago 11, Ill.

DEVELOPMENT ENGINEER — Well established manufacturer whose regular products are in wartime production has a permanent opening for a qualified mechanical engineer. Design and developmental work on special machines and hand tools. Chicago area. In reply please give full details as to education, experience, age, etc. P-847, Product Engineering, 520 N. Michigan Ave., Chicago 11, Ill.

MECHANICAL ENGINEER — Midwest steel company has opening for graduate mechanical engineer. Applicant should have experience in plant layout, machine design and constructions. Give complete record of experience, qualifications, and draft status. Statement of availability required. P-848, Product Engineering, 520 N. Michigan Ave., Chicago 11, Ill.

DRAFTSMEN, DESIGNERS and engineering checkers wanted by manufacturer of Air & Hydraulic Machine Tool Accessories and Special Machinery. Old established firm in midwest town of 20,000 population. Excellent post-war future. Excellent opportunity for advancement. P-849, Product Engineering, 520 N. Michigan Ave., Chicago 11, Ill.

WANTED—APPLICATION and development refrigeration Engineer by well known manufacturer of condensing units. Permanent job offering wide range of activity and responsibility. Write P-850, Product Engineering, 330 W. 42nd St., New York 18, N. Y.

DESIGN ENGINEER. 2 years university training minimum experienced in development and design of amplifiers and vacuum tube control devices. Good post-war future with progressive Chicago manufacturer. P-851, Product Engineering, 520 N. Michigan Ave., Chicago 11, Ill.

EXPERIENCED MACHINE Designer and draftsman wanted by long established eastern manufacturer of Resistance Welding machines. No reconversion problems involved. For the right man this presents a real opportunity for a permanent position with excellent chance for advancement. Present employees are fully informed of this advertisement. Write fully, with assurance of strict confidence. P-853, Product Engineering, 330 W. 42nd St., New York 18, N. Y.

DESIGN ENGINEER Experience in development and design of small electro-mechanical devices such as timers, special relays and automatic control equipment. Good post-war future with progressive Chicago manufacturer. P-852, Product Engineering, 520 N. Michigan Ave., Chicago 11, Ill.

POSITIONS VACANT

ELECTRIC SPOT welder experienced in welding aluminum on a Sciaky machine; give complete details. Benson Manufacturing Company—18th & Agnes Avenue, Kansas City, Missouri.

EMPLOYMENT SERVICE

SALARIED POSITIONS — The advertising service of 34 years' recognized standing negotiates for high salaried supervisory technical and executive positions. Procedure will be individualized to your personal requirements and will not conflict with Manpower Commission's. Retaining fee protected by refund provision. Identity covered and present position protected. Send for details. R. W. Bixby, Inc., 268 Delward Bldg., Buffalo 2, N. Y.

POSITIONS WANTED

CHIEF ENGINEER: Graduate mechanical engineer with twenty years of experience in the design, development and production of domestic and commercial refrigerators, ironers and washing machines also hydraulic pumps, valves and cylinders desires a position as director of engineering. PW-854, Product Engineering, 520 N. Michigan Ave., Chicago 11, Ill.

DEVELOPMENT WORK: Results of independent investigation covering mathematical inter-relationships and determination of properties of metals (critical temperatures, crystal structure, internal stresses, vibration and low-temperature qualities, polarity), available to company interested in development work; services optional on allied research, product development, plant operation, layouts, reports. PW-860, Product Engineering, 330 W. 42nd St., New York 18, N. Y.

SALESMAN AVAILABLE

MECHANICAL ENGINEER Graduate engineer with 10 years practical experience machinery and instrument design, now chief mechanical engineer, desires responsible position with progressive company, development or sales preferred. Age 33. SA-855, Product Engineering, 330 W. 42nd St., New York 18, N. Y.

INVENTORS OR ENGINEERS

If you have a metal product, patented or patent pending, or an invention beyond the idea stage on which you can furnish clear sketches and written description, write us fully about it. We may have an interest in common. Your rights will be scrupulously respected.

NATIONAL MACHINE PRODUCTS
154 West Slauson Ave., Los Angeles 3, Cal.

AVAILABLE
NEW PRODUCTS
Permanent Post-War Opportunity

Capital wanted to start new firm or old firm to start new line. Write for information. Complete data can be furnished and if necessary blue prints. Patent Protection.

BO-842, Product Engineering
520 North Michigan Ave., Chicago 11, Ill.

RARE OPPORTUNITY

Group of new products ready for production. These are production tools in great demand on airplane production and in all metal working plants. No competition. Engineering details completed. $100,000 investment required. You keep complete control. All inquiries answered.

BO-838, Product Engineering
520 N. Michigan Ave. Chicago 11, Ill.

TO INVENTORS
TO MANUFACTURERS

Inventors: Have you patents for disposal here or abroad?
Manufacturers: Are you seeking important new products or processes for present or future exploitation?
W. B. KAHN CO., 551 Fifth Ave., N. Y.
International Patent Brokers • Est. 1904

(U. S. & Foreign Patents for sale on power driven paper cutter.)

OSCAR BELLAR
2017 Woodbine St.
Ridgewood 27, N. Y.

FOR SALE or LICENSE

Two recent patents of proved merit. Locknut, patent 2,355,253 10 claims, pneumatic conveyor, patent 2,301,350 9 claims.

J. E. WHITFIELD
P. O. Box 205 Hamilton, Ohio

WANTED
IN CANADA
PRODUCT TO MANUFACTURE

By a very active and healthy, but small organization in Hamilton, Ontario, Canada, a line of low priced consumer products with good volume which would lend itself to a relatively modest beginning, and rapid expansion both in volume and extension of line of goods when experience has been gained. Either under license or other arrangements. Good trade connection covering all Canada. British Empire export as future goal. Write—

Hamilton Sterling Electrical Co., Ltd.,
Hamilton, Ontario, Canada

Manufacturers
If you are interested in **"IDEAS"** *for Post War Products*
Please Contact Us

Thermostats & Electric Units for Water Heaters
Cast-in Electric Units for Special Machinery
Precision Level Controls for Hot Liquids, Etc.
Small Arms Tools & Sporting Arms Accessories

BARTOLAT & DEMICK
Mechanical & Electrical Research
P.O. Box 554, Tacoma 1, Washington

The
Fischer & Thomas Co.
Product Designers
Creative Ideas for Post-War Mfg.
4815 Superior Ave., Cleveland, 3, O

REED MACHINE & Tool Engineers
Designers & Builders
DIES - JIGS - FIXTURES - GAGES
PRODUCTION WORK
Processing and Consulting Engineers
48 HUMES ST. PAWTUCKET, R. I.
Tel. PErry 5930

PRODUCT DESIGN
Specializing in the exterior styling of Product Design.
ARTHUR SWANSON
and Associates
540 N. Michigan Ave., Chicago 11, Ill.

100 KV TRANSFORMER

For sale unused 100 KV 5KVA testing apparatus with complete control panel, voltmeter, circuit breaker, Variac. Pri. 120/240 volt sec 50/100 KV. Single phase 60 cycle

TITANIUM ALLOY MFG. COMPANY
Niagara Falls, N. Y.

(Additional Employment Advertising on pages 338-339)

SEARCHLIGHT SECTION

WANTED:

NEW POWER PLANT SPECIALTIES

To Manufacture and Market

A manufacturer of steam power plant equipment with 40 years' experience in this field and a nationwide sales organization is interested in adding several new products to his line. This company has a strong financial position and has adequate research facilities for testing new products and doing any further development that may be needed. Address all information to

WITTE & BURDEN • **ADVERTISING**
5757 Cass Ave. Detroit 2, Mich.

POSITION WANTED

Development Engineer

M. I. T. Graduate in Electrical Engineering, 36 years old, with broad research and development background, wishes to locate with progressive manufacturer or laboratory. Ten years experience in successfully developing processes and products in the electrical field. Experience covers all phases of development from appraisal of ideas thru research, design and testing to final adaptation for production. Presently situated in the East, married with family but willing to relocate for advantageous opportunity netting around $12,000.

PW-836, Product Engineering
330 West 42nd St., New York 18, N. Y.

WANTED

DRAFTSMAN

By electrical company manufacturing motor driven electric appliances 45 years in business. Real opportunity is offered permanent position and steady advancement. Company now engaged in 100% war work and starting post war planning. Statement of availability, references, and personal status required.

P-858, Product Engineering
330 West 42nd St., New York 18, N. Y.

WANTED

ENGINEERING DRAFTSMEN

For design and development of insulation board mill equipment and allied machinery. Permanent position. Experience in design of paper mill equipment helpful but not required. Location South. State draft status and availability with complete details of experience.

P-844, Product Engineering
520 N. Michigan Ave., Chicago 11, Ill.

TECHNICAL ASSISTANT

TO SALES MANAGER

• Well-financed aggressive national corporation requires sales manager's overall technical assistant, having exceptionally broad engineering background in aircraft hydraulic, mechanical, electrical engineering including some marine or railroad experience. Minimum of 12 years' engineering experience essential. Must be sales-minded with executive ability as staff of sales engineers will report directly to him. Large current armament volume plus broad postwar application of products assures good future.

Also require two specialized technical assistants reporting to above executive —one with minimum of 8 years aircraft engineering experience, particularly on control devices; the other with 10 years marine engineering experience. In reply, submit concise but complete details in first letter, stating salary requirements, experience, etc.

SW-857, Product Engineering
68 Post St., San Francisco 4, Calif.

ENGINEER

Design and shop engineer to assume supervision of mechanical design and job shop operations. Permanent position with research laboratory operating a well equipped modern machine shop to serve departments in chemical engineering, physics, metallurgy, mineralogy and product development. Position requires ability to design and build equipment from ideas other than from conventional blue prints and to assist research scientists in development problems. Must supervise 25-35 men. Give all details of past experience and earnings in your reply.

ARMOUR RESEARCH FOUNDATION
35 West 33rd Street Chicago 16, Illinois

POSITION WANTED

PRACTICAL MAN

Experienced in designing and supervising manufacture of dies, tools, and machinery for light mass production. Knows how to get willing cooperation all down the line. No college but broad practical experience, and plenty of good workable ideas. Now in charge of small plant with excellent production record. Wants supervision of plant or engineering department with progressive firm. Salary must be over $10,000.

PW-843, Product Engineering
330 W. 42nd St., New York 18, N. Y.

TOOL DESIGNER

Active Midwest tool company wants experienced man immediately and for post-war work to design carbide cutting tools and dies. Salary open. Address reply to

P-840, Product Engineering
330 West 42nd Street, New York 18, N. Y.

ENGINEER WANTED

Well established New England Company, recognized leader in its field, which, however, is one in which production methods have not fully kept pace with modern developments, offers opportunity for progressive engineer.

Applicant must be conversant with layout of operations to result in effective utilization of equipment for increased production. Experience in a progressive manufacturing industry is required. Personality and character must be such as to assure goodwill of operators utilizing the equipment. Education in metallurgical or mechanical engineering desirable.

For the man with proper background the position offers excellent possibilities in an industry where much remains to be done and with a company whose progressive management will encourage initiative and show appreciation for results.

Company is at present engaged in war work but has been very successful in peace time. Products are high-class metal goods and small assemblies, and are sold to a diversified field. Immediate availability is not required. Apply

P-837, Product Engineering
330 West 42nd St., New York 18, N. Y.

WANTED

Draftsmen—Detailers Layoutmen

—With Eyes On The Future

Top flight manufacturer of quality engines offers real opportunity to several draftsmen who have a lot on the ball and eyes on the future. Medium-sized organization that's climbing fast. Good living conditions and adequate salary. Tell us all about yourself in strict confidence. Write

P-834, Product Engineering
330 W. 42nd St., New York 18, N. Y.

KEY MEN NEEDED

Men for key positions are needed to continue our expansion for present war contracts and contracts for post war motors. We specialize on all types fractional horsepower electric motors and need men for key positions in—

Series Motor Engineer
Induction Motor Engineer
Tool Design Engineer
Manufacturing Supt.
Also **Tool Draftsman**
Design Draftsman

If you are experienced in any of these lines you can share a very interesting and prosperous future with us.

UNIVERSAL ELECTRIC COMPANY
300 East Main Street Owosso, Michigan
Our employees have the Army Navy "E" Award

ELECTRONIC EXPERT

Needed in management of large New York plant. Capable of supervising manufacture of transmitting and receiving radio assemblies, transformers and other electronic equipment. Excellent opportunity. Write personal and professional qualifications, salary expected.

Box 211, Suite 1024
122 E. 42nd St., N. Y. 17

SEARCHLIGHT SECTION

DESIGNERS & DETAILERS

of mechanical parts

& PROJECT, SENIOR & JUNIOR

DEVELOPMENT & PRODUCTION ENGINEERS

on optical, mechanical, electrical devices

for war & post war use

Send complete resume or come to Personnel Department

FAIRCHILD
CAMERA & INSTRUMENT CORP.
475 10 Ave. (36 St.) N. Y. C.

WANTED

VALVE DESIGN ENGINEER

Established manufacturer of oil field equipment in Houston, Texas desires to expand its valve line to serve other industries. Applicant should be fully familiar with service requirements of valves for a wide variety of applications, and capable of assuming considerable responsibility in design and development. Application should include age, experience, and salary expected.

P-841, Product Engineering
520 North Michigan Ave., Chicago 11, Ill.

TOOL OR DIE DESIGNERS

Ohio Manufacturer with Die-Cast Division, needs Tool or Die Designers to design Die-Cast Dies, Tools, Jigs, and Fixtures. Broad experience with Machine Tools essential. Some Mechanical and Hydraulic Engineering experience advantageous. Living conditions good in small town, or near-by medium sized city. Excellent post-war opportunities. W. M. C. Rules apply.

P-839, Product Engineering
520 North Michigan Ave., Chicago 11, Ill.

WANTED

By

RBM Manufacturing Co.

Division of Essex Wire Corp.
Logansport, Ind.

DESIGN LAYOUT DRAFTSMAN
PRODUCT DESIGNERS
ELECTRICAL ENGINEERS

These positions offer real opportunities for advancement now and in the post-war era to those men who can design:

RELAYS
SOLENOIDS
VOLTAGE REGULATORS
SWITCHES
REMOTE CONTROL MECHANISMS
OVERLOAD CIRCUIT BREAKERS
ELECTRONIC DEVICES

Let us hear from you

Wanted
ENGINEERS

Radio
Chemical
*** Electrical**
Electronic
*** Mechanical**
Metallurgical
*** Factory Planning**
Materials Handling
Manufacturing Planning

Work in connection with the manufacture of a wide variety of new and advanced types of communications equipment and special electronic products.

Apply (or write), giving full qualifications, to:

R. L. D., EMPLOYMENT DEPT.

Western Electric Co.

100 CENTRAL AV., KEARNY, N. J.
*** Also: C. A. L.**
Locust St., Haverhill, Mass.

Applicants must comply with WMC regulations

WANTED

ELECTRICAL ENGINEER

Old progressive company 45 years in business offers real opportunity for permanent position and steady advancement for engineer having several years experience in small electric motors. Company is now doing 100% war work and is starting post war planning. Statement of availability, references, and personal status required.

P-850, Product Engineering
330 West 42nd St., New York 18, N. Y.

PRODUCT ENGINEER

WANTED

A well financed, leading manufacturer, located in middle west, has opening for an engineer with experience in design and application of air control valves. Must have a thorough mechanical background. Give complete details of personal qualifications, age, draft status, work history, present earnings and salary expected, in letter of application. Statement of availability required. All information held in confidence.

P-835, Product Engineering
330 W. 42nd St., New York 18, N. Y.

WANTED

Production Engineer

Fractional H. P. Electric Motors

Should have specialty background in single phase motors, having devoted major effort to efficient mass production. Line will have limited size range. Engineering design experience desirable for development of motors for tooling and production. Permanent connection with outstanding Southern California manufacturer entering household appliance field. Send detail of experience and personal qualifications to A. W. A., Box 68 Station K, Los Angeles, California.

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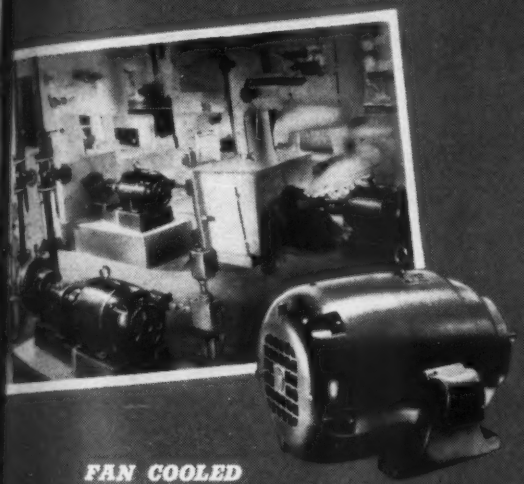

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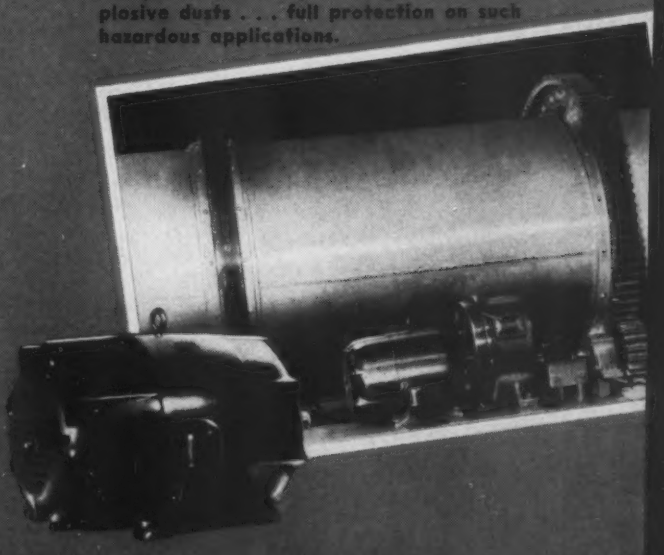

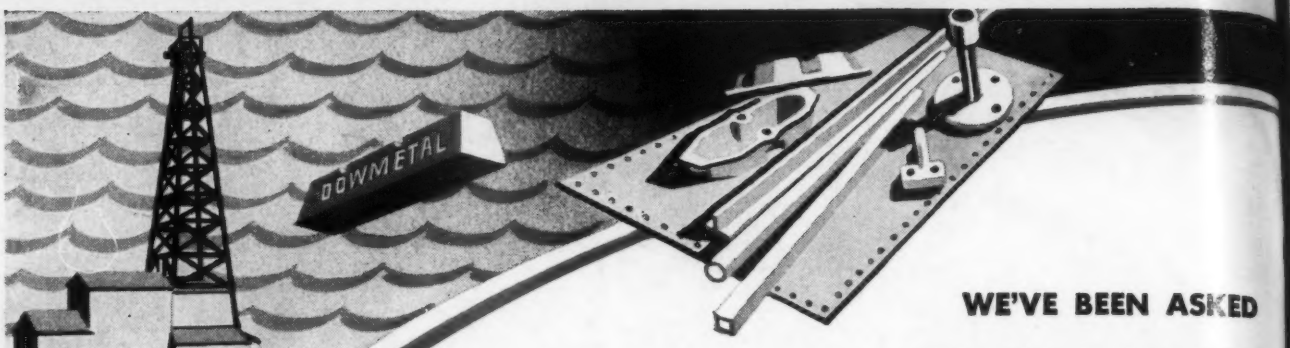

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